A capstone project submitted to the UC Berkeley School of Information as partial fulfillment for the degree of Masters of Information Management and Systems

Submitted: May 4, 2006

Project Team:

Carrie Burgener
carrie@sims.berkeley.edu

Scott Fisher
sbfisher@sims.berkeley.edu

Mike Wooldridge
mikew@sims.berkeley.edu

http://www.health-tracker.info

Acknowledgements

Thanks to Professor Marti Hearst for her guidance as our faculty advisor; to Professor Deryk Van Brunt for encouraging our work and introducing us to many relevant health topics in his Information Systems in Public Health class; to Professor Marc Davis, for sparking our interest in mobile-computing technology through his teaching and for his mentorship at Garage Cinema Research; to Dr. Randi Weinstein for her expert advice on the topic of fertility; and to the dozens of volunteers inside and outside of the UC Berkeley School of Information who filled out our surveys, talked candidly to us about their diary experiences, and patiently completed user tests for the different Health Tracker prototypes.

Table of Contents

Acknowledgements i
Table of Contents ii
Abstract 1
Introduction 2
  Why We Chose the Topic 2
  Scope of the Project 3
  Overview of the Paper 4
  Design Examples 7
Background Research 8
  Literature Review 8
  Technology Survey of Health Professionals 9
  Self-Testing of Fertility Tracking Methods 13
  Analysis of Related Products 14
  Fertility Background and Terminology 15
Persona Development 17
  Our Rationale 17
  Persona Characterizations 17
Prototypes 21
  Preliminary Sketches and Ideas 21
  Paper Prototype I 21
  Paper Prototype II 23
  Week-Long Reminder Study 26
  Interactive Prototype 27
Final On-Phone Prototype 29
  On-Phone Prototype Technology 30
  User Interface Flow Diagrams 32
Discussion and Analysis 34
  What the Project Borrowed 34
  What the Project Innovated 35
  Design Challenges 36
  Lessons Learned 38
  Future Directions 39
Bibliography 40
Appendix A: Survey for Health Professionals 40
Appendix B: Healthcare Professional Survey Results 50
Appendix C: Diary Keeper Interview Questions 56
Appendix D: Diary Keeper Interviews 58
Appendix E: Self-Testing of Fertility Tracking Notes 75
Appendix F: Paper Prototype #1 Screens 79
Appendix G: Paper Prototype #2 Screens 83
Appendix H: Reminder Testing Pre-Test Survey 90
Appendix I: Reminder Testing User Journal Forms 93
Appendix J: Reminder Testing Post-Test Survey 102
Appendix K: Fertility Brochure 104

Abstract

Health Tracker is a prototype mobile-phone application that enables women to track and predict their fertility. Users record their monthly cycle information and results of fertility tests in Health Tracker, and the application displays estimates of future fertility based on the entries. Women can use the application to send fertility information to others—for instance, their partner or healthcare provider—and to set up automatic reminders for common tests.

Health Tracker helps people take a more active role in monitoring their health using their mobile phone, which is usually close at hand. We believe Health Tracker's design can serve as a model for other health journaling applications.

Introduction

Why We Chose the Topic

Our decision to pursue Health Tracker as a final project was influenced by new technology's impact on how the average person approaches healthcare. Research shows that more and more people are searching online for health-related information before, during, and after their medical treatment (Forkner-Dunn). Health-oriented online services are becoming more popular, enabling users to track fertility, weight loss, exercise, and other personal information (Fox). Communication between patient and doctor using e-mail and other Internet technologies is also becoming more common (Moyer, Katz).

There has been a strong trend in recent decades for women to have children later and later in life. Since fertility decreases as women age, they must often take extra steps to maximize the chances of conception (DeCherney, Stovall). They can predict their ovulation by monitoring their monthly cycle, tracking basal body temperature, or checking hormone levels using over-the-counter ovulation tests.

Developing a fertility-tracking application on a mobile phone makes sense for a variety of reasons:

- Some of the tests a woman takes to track her fertility must be done at specific times of the day to be valid. A mobile phone can remind her to perform such tests.
- Graphing and interpreting basal body temperature results on paper can be time-consuming and tedious. With a phone-based application, users can enter the information and have the results interpreted automatically.
- Although PC-based fertility systems are already on the market, having a mobile-phone-based application means users can continue recording health information even when not at a computer.
- Recording sensitive information on a small mobile-phone screen means there is less chance others will see what you are entering.
- Fertility tracking generally involves simple data entry. Users typically answer yes-or-no questions or temperature values using the standard keys on a phone.
- Mobile phones offer cost-saving advantages since most people already own such devices.

Personal Motivation

The three team members also had strong motivating interests in the areas of mobile computing and user-interface design. Health Tracker elaborates on skill sets developed during other School of Information projects.

PicturePortal and iTour: During their first semester at the School of Information, Carrie, Scott, and Mike took IS 202, which included a group project where students designed context-aware applications for mobile devices. Mike and his group designed PicturePortal, a photo management system that enabled users to automatically control access to their photo collections based on when, where, and around whom the photos were taken. Carrie and Scott and their group designed iTour, a location-aware multimedia tour guide and photo portal. These projects included some of the user-centered design practices used in the Health Tracker project, including the development of personas and scenarios.

PhotoCat: During their second semester, Carrie, Scott, and Mike teamed up in IS 213 (with an additional group member, Andrea Nelson) to develop PhotoCat. PhotoCat was a Web-based photo management application. PhotoCat enabled users to view and manage their digital photo collections using a circular "bull's eye" interface that organized photos based on the time they were taken. The group completed an intensive user-interface design process that included development of scenarios and personas, several iterations of paper-based and interactive prototypes, and heuristic evaluations by other students in the class. The IS 213 development process served as model for that of Health Tracker. IS 213 is taught by Professor Marti Hearst, who is the faculty advisor for this final project.

Mobile Media Metadata 2: All three of the Health Tracker team members spent time working on Mobile Media Metadata 2 (MMM2), a project led by Professor Marc Davis. MMM2 helps people organize and share digital photos based on metadata that is automatically captured by camera phones. Carrie was the interaction design lead on the MMM2 project while Scott and Mike worked on Web and Interface development. MMM2 gave the three of us hands-on experience developing a complex software application that was actively used by students at the School of Information.

Other Notable Projects: Mike and Carrie worked on information visualization projects during fall 2005 that influenced elements of Health Tracker's design such as the graph view. During the same period, Scott worked on the design of a real-time bus schedule product for mobile phones. The project considered issues related to entering data and obtaining information with a mobile phone in a public environment.

Scope of the Project

Health Tracker was a user-interface design project that employed user-centered design methodology. As such, it involved:

- Exploring the needs of users through surveys, interviews, and real-world simulations.
- Modeling and focusing on user needs through personas and scenarios.
- Studying how users interacted with the design through low-fidelity and interactive prototypes.

We focused on women who are tracking their fertility as our primary users. Healthcare professionals could be considered another type of user in some circumstances, but we found when looking at use scenarios that they were not always involved. We eliminated healthcare workers as our focus after doing preliminary research and assessing the needs of people who would be likely to use the system.

We designed Health Tracker to run on Symbian Series 60 mobile phones. Symbian is the leading software platform for converged mobile devices.[1] The three team members had experience designing for Symbian-based mobile phones in past research projects.

What We Didn't Do

Health Tracker *was not* a software development project. We didn't design an underlying data model for how information retrieved from the user is represented and stored. We also didn't address the question of where the information is stored. Nor did we implement algorithms that analyzed fertility data and determined future fertility trends. We would need to complete these and other tasks to have a fully working fertility tracking system.

Overview of the Paper

This paper describes, in chronological order, the steps we took to develop Health Tracker, starting with background research and ending with an on-phone prototype. What follows is a summary of these steps.

Background Research

We spent the first few weeks of the project evaluating the literature, potential users, and existing products.

Literature Review: We reviewed over fifty academic articles, product descriptions, and Web sites dealing with technology use in health and medicine.

Technology Survey of Health Professionals: We used a Web-based survey to learn about doctors' and nurses' use of mobile devices in the workplace.

[1] http://www.pcmag.com/image_popup/0,1871,s=27114&iid=114385,00.asp

Health Journaling Interviews: Through user interviews with diary keepers, we found out how people keep track of personal health information in areas such as diet, exercise, sleep, and fertility.

Self-Testing of Fertility Tracking Methods: Team members pretended to track their fertility over a week

Analysis of Related Products: We looked at existing commercial systems used to monitor different types of health information. Over half of the products we looked at were for tracking fertility.

To get familiar with the fertility subject area, we reviewed a number of articles on fertility tracking and prediction. We include a summary of this information in **Fertility Background and Terminology** as well as in the brochure we developed for our users (see Appendix K).

Persona Development

After completing the background research, we developed a number of *personas*—detailed descriptions of fictitious characters who would be likely to use our application. We also devised a list of tasks that users of our application might want to complete.

To help us decide which tasks to focus on during our development, we devised a *task matrix* in which we estimated the importance of each task for each of our personas.

Finally, we selected a primary persona on which to focus our attention. The primary persona's needs were most representative of the typical users who would be using Health Tracker.

Prototypes

We developed the Health Tracker design in an iterative fashion, where each version of the design was tested on users and critiqued by the team. The following represent the iterations of the design:

Preliminary Sketches and Ideas: Using what we learned from our background research and persona analysis, we came up with a preliminary set of screens, many of them pencil sketches.

Paper Prototype I: After a discussion of the different initial sketches, we created an initial set of paper-based screens. We then performed our first round of user tests using these screens.

Paper Prototype II: Using the feedback from our first round of user tests, we updated our paper-based design and tested again.

Week-long Reminder Study: To better understand how Health Tracker's reminder system would work in the real world, we simulated it using text messaging. Three users received wakeup messages every day for a week.

Interactive Prototype: Working in Flash Lite, we developed an interactive prototype that ran on a PC-based phone simulator. We tested the prototype on users.

Final On-Phone Prototype

The culmination of our research, design iterations, and user testing was a Flash-based prototype of Health Tracker that runs on Nokia Series 60 phones. The on-phone prototype includes the following:

The **main screen** from which users enter data about basal body temperature, luteinizing hormone tests, and menstrual periods

A **calendar view** that displays a month's worth of fertility information. The user can select dates on the calendar using the phone's 4-way button

A **graph view** that displays a month's worth of basal body temperatures. The user can select points on the graph using the phone joystick.

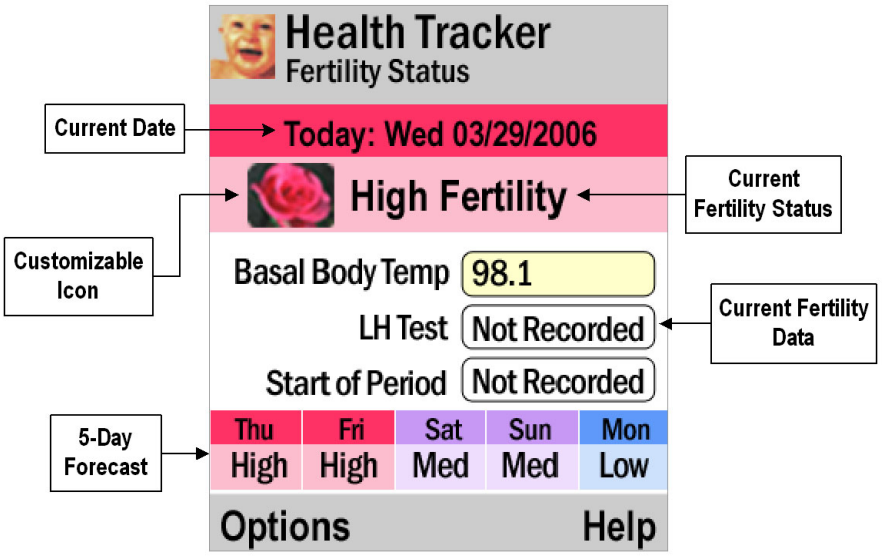
A series of **setup wizard screens** that simulate configuring the application for first use

A series of **send data screens** that simulate sending fertility data to a contact via text message or e-mail

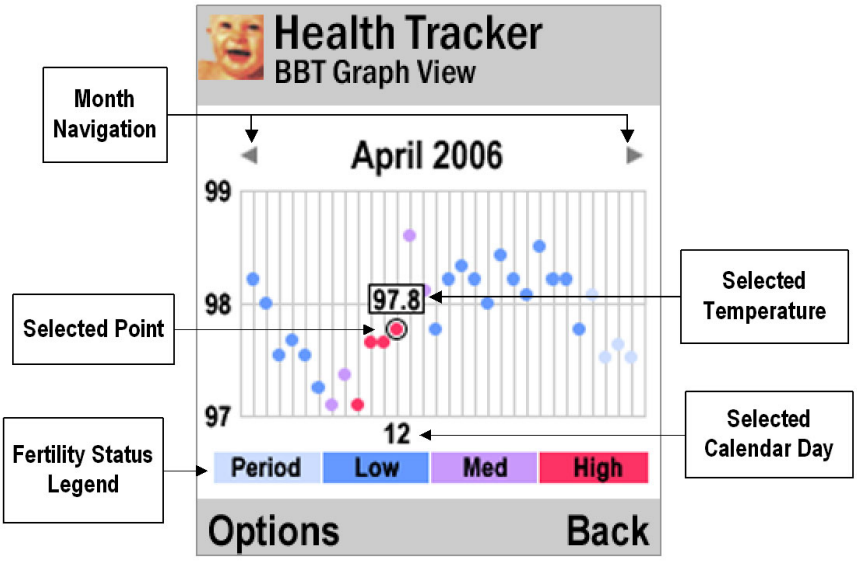
A series of **backup screens** that simulate exporting data from the application via e-mail

Design Examples

Below is the Health Tracker main screen. It enables a user to check their current fertility status, view and enter their fertility data, and see a fertility forecast for the next five days.



Below is the Health Tracker graph view. It enables a user to see trends in their basal body temperature measurements. The view represents a simplified, digital version of the paper-based graphing that is often done by women who are tracking their fertility. A more detailed screen description and analysis of this view is included in the Prototypes section starting on page 20.



Background Research

Literature Review

We reviewed over fifty academic articles, product descriptions, and Web sites dealing with technology use in health and medicine. This review helped us identify a particular health topic (fertility) and audience (patients rather than health professionals) on which to focus. What follows is a summary of the key areas that we investigated. For a detailed list of resources, see the bibliography.

Medical Mobile Computing

Doctors and other health professionals are increasingly using mobile computing as a way of referencing medical data (for instance, prescription drug information) and communicating with colleagues and patients. The number of doctors using mobile devices is expected to increase as hospitals and regional health providers move to electronic medical record (EMR) systems. While we didn't end up designing our application for use by health professionals, examining this area gave us a sense of where the medical field stands with respect to mobile-device use. We explore this subject further with our Technology Survey of Health Professionals.

Telemedicine

Telemedicine is medicine that is carried out remotely via the Internet, wireless technology, and other distributed information technologies. Telemedicine plays a key role in monitoring and treating persons who live in remote rural areas, patients being transported by ambulance, and even astronauts on the space shuttle. In some telemedicine situations, patients fill out electronic symptom journals to help ensure that doctors have the necessary information to make informed health decisions remotely.

Ecological Momentary Assessment

In the behavioral sciences, diary keeping for research purposes is known as Ecological Momentary Assessment (EMA). EMA deals with collecting patient-recorded outcomes during research in real-world situations. The goal of many EMA practitioners is similar to our project's mission: to provide users with a journal system that is easy to use and accurately conveys information about health status. While EMA has been traditionally performed using paper diaries, many of today's EMA studies use electronic devices to collect data. This has led to increases in convenience (for users and researchers) as well as accuracy.

Fertility Tracking and Prediction

We examined a variety of techniques for tracking and predicting fertility, including analyzing the menstrual cycle, monitoring basal body temperature (BBT) and luteinizing hormone (LH) levels, tracking changes in cervical mucus consistency, and checking for "fern" in saliva. Of these techniques, keeping track of the menstrual cycle combined with BBT and LH tests seemed to be the most practical way of tracking fertility given our users' needs and the interface constraints of mobile phones. The information gathered here served as a basis for our paper-based brochure, which provides users with background on fertility prediction.

Technology Survey of Health Professionals

Our initial research included a survey of health professionals about their use of mobile devices in the workplace. While the academic literature includes various examples of how handheld computers are changing the way medicine is practiced (for instance, via drug-reference and patient-tracking applications) (McAlearney, Carroll), we wanted to get information from everyday doctors and nurses about how such technology is (or isn't) affecting them.

Our survey suggests that healthcare is in a state of transition with respect to mobile devices and information technology. According to our respondents, there is an awareness of the potential for mobile devices to help healthcare professionals to do their work, but the technology isn't implemented yet on a widespread basis. Surveying more people from a greater variety of healthcare areas could give us a better idea about whether the trends from this study hold true for the medical profession as a whole.

	Respondent #1	Respondent #2	Respondent #3	Respondent #4	Respondent #5
Occupation	Physician	Clinical Research Nurse, RN	Hospital Administrator	RN	Physician
Specialty	Emergency Medicine	HPV Vaccine Research	Long-term care	Family practice	Emergency Medicine
Age	30-39 years	40-49 years	50-59 years	60 years or older	60 years or older
Experience	6 to 10 years	6 to 10 years	More than 20 years	More than 20 years	More than 20 years
Mobile Device Use	Phone	None	Phone	Phone	Phone, PDA

Respondents were recruited through the project team's personal contacts. The survey included 38 questions (see Appendix A) and was posted on as a Web-based survey (see Appendix B for the results).

Key Results

Use of Mobile Devices

All but one (a nurse) uses a mobile phone. All the mobile-phone users used them for voice calls. Two used them for text

messaging. One used it for taking photos. Only one (a doctor) uses a PDA. Respondents said they and their colleagues used mobile devices at work to communicate with one another, to look up drug and other medical information, and as pagers.

Medical Journals for Patients

Both doctors in the survey had asked patients to keep health journals at least one time in the past. The patients were instructed to enter medication information, vital signs, and symptoms in the journals. One of the nurses also had patients keep journals to monitor temperature, symptoms after injection, and medication information. All of the journals mentioned by the respondents were paper-based.

Value of Health Tracking on Mobile Device

Perceived advantages of recording electronic data were being able to monitor compliance with medical instructions and the ability to more closely monitor drug interactions.

Most of the respondents (4 out of 5) wanted to view the information at appointments. Some also wanted to view the data between appointments, when they phoned, or when certain entries raised "red flags." There was no consensus as to whether viewing the data as text and numbers or visually as charts and graphs was preferred.

Ease of Use Was Biggest Challenge.

Respondents thought both patients and doctors might have problems learning how to use systems on a mobile device. One of the nurses mentioned confidentiality issues. One of the doctors mentioned problems with non-meaningful data.

Current Mobile Journaling Products in Healthcare

Some respondents were aware of other journal systems being used in healthcare. Neither of the doctors was aware of such systems, but both of the nurses knew of diabetic-monitoring devices. The healthcare administrator was very knowledgeable about home health monitoring devices.

Cost an Important Factor

Most respondents thought cost would be an important factor in whether health tracking by mobile device might be adopted. Four out of five said cost was probably an important factor. One of the nurses said that it would be more important for patients than providers.

"Dream" Health Monitoring System

The descriptions of a "dream" health monitoring system varied among respondents. Most of the respondents' descriptions centered on the systems giving the healthcare provider more immediate and accurate access to critical health information. One of the nurses described a system that would include video conferencing for assessing a patient's well being. The other nurse

mentioned automatic alerts and the ability to send messages back and forth with a patient.

Health Journaling Interviews

We interviewed five diary keepers to find out how people keep track of health and lifestyle information over time. This information would complement what we learned about diary keeping from our literature review (Stone, Bolger).

Some of the information we were interested in discussing with the interviewees was the format and frequency of diary entries. This would guide us in creating an entry interface on a mobile phone that would be easy to use. We also wanted to find out if they had ever shared their diary information, or if they thought an electronic reminder system would've been helpful. Sharing and reminders were two features that we thought were particularly apt for a mobile device-based system.

	Interviewee 1	**Interviewee 2**	**Interviewee 3**	**Interviewee 4**	**Interviewee 5**
Occupation	Student	Business Development	Homemaker	Attorney	Student
Gender/Age	Female/20s	Male/30s	Female/40s	Female/30s	Female/30s
Diary Topic	Diet	Sleep	Fertility	Fertility	Exercise
Format	Online	Paper	Paper	Paper	Online
Duration	9 months	5 months	2 months	Several months	Several months
Interview Type	Face-to-face	Face-to-face	Face-to-face	Phone	Face-to-face

Respondents were recruited through the project team's personal contacts. The survey included 10 questions about their personal diary use and 10 questions about what they thought of mobile-device-based diaries (see Appendix C).

Key Findings

Information Recording Frequency and Accuracy

All but one of the people we interviewed engaged in some potentially data-generating activity on a daily or nearly-daily basis for periods of two months or longer. The one person who did not generate data daily was only interested in obtaining data near her times of ovulation (for fertility purposes). Despite data being generated on a regular daily basis, few of the interviewees recorded the data every day. Four admitted to recording the data only 2 or 3 times a week or "every few days."

Four people admitted that the accuracy of the data was sometimes questionable because of the time between the data being observed and it being recorded. This was not a large concern for at least one of the people. She was doing a sports training program as a hobby and did not feel that she needed extremely accurate data. She felt that the extra effort of getting very accurate data was not worth the inconvenience of frequent recording on her desktop computer.

Mobile Electronic Recording

Surprisingly, only three of the interviewees had a strong positive response to recording data on a portable device. The two women who had used a diary to gauge their fertility said they had recorded things on paper and did not feel the need to use an electronic device. One of these women commented that her husband seemed more likely to use a portable device than she did, and that she did not use her mobile phone for anything but phone calls. Some of the reluctance seemed to stem from limited use of the technology in the past. Even though she said she didn't see herself doing things this way, she also commented about difficulty in analyzing the data by flipping through pages in her diary and indicated that software might be useful for data analysis and seeing trends or cycles more clearly.

Uses and Features

When asked, four out of the five interviewees said they would like to get reminders to enter data. One said she would find such reminders annoying since she was already aware of the need to enter information and didn't want her device bothering about something of which she was already aware. Overall, people were very positive about getting reminders, however.

Four of five said they shared their information with others. They shared with a doctor (2 interviewees), an exercise coach (1), and a husband (1). The 4 people said they might share their information wirelessly with others, but it depended on the situation and whether such sharing was expected. One mentioned privacy concerns associated with wireless data transfer.

Only two felt that printouts were useful and one other person thought they might be useful in some cases depending on the situation. The two that thought printouts were very useful were the same people who had recorded things on paper and were not familiar with their mobile phones beyond making phone calls.

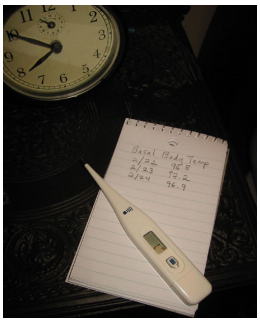
Two people felt that voice recording might be useful and one felt that taking photos would be.

Unanticipated Comments

Two participants noted that having involvement with other people would be useful in motivating them to continue with their diary and health program. For example one said that she felt motivated to record things because her online coach looked at the entries she made. Another mentioned involvement with others as a factor that might improve her chances of success in her diet goals. Whether to routinely involve other people seemed to depend on the reason for keeping a diary.

One participant felt that measuring for luteinizing hormone was the most important thing she did in maximizing her chances of pregnancy. She said other methods were more work and not very useful to her.

Finally, a participant said that an understanding of the reasons for keeping a diary was very important in order to maintain motivation for recording information. The participant also noted that certain types of free-text data would be hard to enter on the phone or certain types of mobile devices



Self-Testing of Fertility Tracking Methods

The following paragraphs describe common testing methods that group members tried in order to be familiar with the procedures.

Basal Body Temperature (BBT) Testing: By measuring body temperature immediately upon waking throughout her cycle, a woman can pinpoint her ovulation with a high degree of accuracy. At the beginning of her cycle, body temperature will typically remain steady for about two weeks. Then, just after ovulation, there will be a spike in temperature of 0.5 to 1.6 degrees F. Since the spike happens after ovulation, a BBT test doesn't help predict additional high-fertility days for the current cycle. Charting information for several ovulation cycles can help you predict future ovulations. BBT testing is performed using a highly accurate basal thermometer.

Luteinizing Hormone (LH) Testing: Available over the counter at drugstores, LH test kits enable women to predict fertile days before they happen by measuring the level of LH in urine. LH levels rise just prior to ovulation. On the middle days of the cycle, urine is tested using a small white stick. After waiting a few minutes a mark on the stick appears indicating the level of this hormone (and current fertility)

Performing these self-tests helped us better understand the challenges women might face when recording fertility information on a mobile device. (See full notes Appendix E.)

Key Findings

Make Data Entry Simple

Data entry needs to be simple since women will typically be entering this ovulation data many times over a time period of weeks or months. We should try to minimize the number of clicks and length of time it takes a woman to enter a temperature reading or the result of an LH test.

Location-Related Advantages

Location makes a mobile device advantageous. Women will probably be entering the information in places where they don't normally interact with technology—in their beds and in their bathrooms. This could make tracking information using a mobile phone more convenient than tracking it on a PC.

Special Challenges of BBT Testing

In the case of BBT testing, women may be entering the information in a dimly lit room or without glasses or contacts. These are issues to consider when designing the user interface.

Analysis of Related Products

Before starting the design process, we evaluated a variety of systems for tracking health information.

Fertility Tracking Systems

The four fertility systems we compared were *EggAlert*, *OmaiGino*, *Taking Charge of Your Fertility* and *MyMonthlyCycles*. A summary of the systems is presented below.

	EggAlert[2]	OmaiGino[3]	Taking Charge of Your Fertility[4]	MyMonthlyCycles[5]
Platform	Mobile+Web	Mobile	Software	Web
Cost	$5.95/3 mo.	$15.99	$39.95	$24.95/year
Predict menstruation?	Yes	No	Yes	Yes
Predict ovulation?	Yes	Yes	Yes	Yes
Predict due date?	No	No	Yes	Yes
Predict gender?	No	Yes	Yes	No
Track BBT?	No	No	Yes	Yes
Track LH surge?	No	No	Yes	Yes
Track cervical mucus?	No	No	Yes	Yes
Track PMS?	No	No	Yes	Yes
Track intercourse?	No	No	Yes	Yes
Visual tools?	No	No	Calendar, charts	Calendar, charts
Reminders?	Yes: SMS	No	Yes: computer	Yes: via e-mail
Publish to Web?	No	No	Yes	On Web

The systems varied in the technology used and the depth of information they requested from users. *EggAlert* and *OmaiGino* were mobile phone-based systems. *EggAlert* tracked fertility by having users fill in their monthly cycle information on a web site. Then the system sent mobile-phone text messages to remind users of periods of high fertility. With *OmaiGino*, users entered their cycle information directly on their mobile phones and could then view fertility predictions on their phones. *Taking Charge of Your Fertility* was standalone software that ran on a PC while *MyMontlyCycles* was a Web-based application.

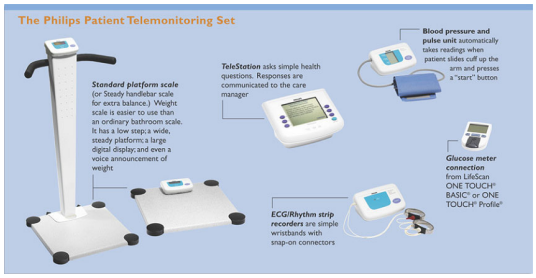
The two mobile systems used period start date and other timing considerations to estimate fertility levels. *Taking Charge of Your Fertility* and *MyMonthlyCycles* were more full featured and let the

[2] http://www.eggalert.com
[3] http://www.omaitek.com
[4] http://www.ovusoft.com
[5] http://www.mymonthlycycles.com

user record a wide array of fertility predictors such as basal body temperature, luteinizing hormone levels, cervical mucus consistency, and cervical position. Users could estimate their fertility based on these predictors using various calendars and charts. *Taking Charge of Your Fertility* also included a calendar that displayed appointment information in addition to fertility reminders.

Overall, we thought that the mobile-based applications were limited in their functionality and could be improved by integrating some of the more visual features seen in the desktop systems. In the design phase, one of our tasks would be to decide which of the desktop features were most important to our prospective users and how such features might be realized on a mobile phone.

Other Non-Fertility Tracking Systems



Telemedicine monitoring systems use biometric sensors attached to the body to obtain health data from patients automatically. This data can include heart rate, blood pressure, and other physiological signs. Such a system needs very little interaction from the user after the device is attached. Telemedicine monitoring is used in space-flight medicine, ambulance transport, and home-based health monitoring (Tachakra 252-253). These systems generally send the data back to doctors wirelessly and in real-time (see Tachakra 252-253, Voskarides 1-2).

We also looked at traditional medical journal systems that tracked information about mood (Karlinsky, Kreindler), pain (Stone), drug effects (Koop), diet (Connelly), asthma (Byrom), or smoking cessation (Shiffman). These diary systems rely on patients to self-report their conditions in either an electronic or paper diary. Some studies compared the effectiveness of electronic versus paper diaries (Stone, Koop, Aaron, Quinn, Johannes).

Finally, some of the diary systems we examined in the literature were automated “appliance” systems that fell somewhere between telemedicine devices and medical diaries. Companies such as Philips, Life Link, and Honeywell make systems that monitor blood pressure, body weight, blood glucose, and other signs. The systems include a base station that automatically uploads data over a phone line. Though users of these appliance systems need to complete tests on schedule, there is minimal self-reporting of information.

Fertility Background and Terminology

Most people are familiar with the menstrual cycle but they may not be as familiar with the fertility cycle to which it is related.

The menstrual cycle begins with bleeding and sloughing off of blood and tissue from the uterus. Fertility is lowest at this time since menstruation does not create a friendly environment for fertilization.

The first half of the menstrual cycle is called the **follicular stage** since follicles inside the woman's body prepare themselves to release an egg. The release usually occurs between days 12 and 14 of the cycle. It is prompted by an increase of **luteinizing hormone** that helps weaken the follicle containing the egg. Egg release from the ovary, or **ovulation**, occurs. Within the approximately 24 hours afterwards, the egg can become fertilized (American Fertility Association "Understanding Your Most Fertile Time"). The period after ovulation is known as the **luteal phase** and is marked by decreasing fertility.

A woman has the greatest chance of conceiving if she has intercourse in the days just before ovulation or immediately following it. Timing intercourse just before ovulation is often effective since sperm can live for several days and the woman has high chances of become pregnant if they are already present when the egg is released.

Measurements can be taken to further pinpoint the most fertile times.

- Period start date and length are monitored to estimate by timing.
- Basal body temperature (BBT) is measured by checking the resting body temperature first thing in the morning before performing other activities. BBT rises slightly when ovulation occurs. It must be measured with a "basal" thermometer that has at least 0.1 degree accuracy to obtain useful results.
- Luteinizing hormone (LH) is measured using commercially available ovulation tests. LH spikes just before ovulation. Commercial ovulation tests are similar to home pregnancy tests and measure this spike. The tests are taken by urinating on a test stick and then checking the results after waiting briefly.
- Cervical mucus changes consistency and resembles raw egg whites when fertility is highest. The cervix also changes position.
- A less-used test involves examining saliva for "ferning" characteristics.

We de-emphasized the cervical mucus and position test when working on Health Tracker since the women we talked with expressed more interest in BBT and LH tests and because they were also not as comfortable monitoring their cervical characteristics. The saliva test seems relatively uncommon in all the background information we examined.

Persona Development

Our Rationale

The team developed five personas to help inform the design of Health Tracker. We picked types of individuals that would use fertility tracking software for traditional, and perhaps non-traditional, purposes. Having personas to focus on during the design process would help us test our assumptions about features and how the application should function.

We showed our personas and their respective scenarios to a fertility expert from the University of Arizona, Dr. Randi Weinstein. She confirmed that they were accurate depictions of potential users of our application. She liked the idea of including women who were tracking their fertility for reasons other than getting pregnant.

Persona Characterizations

Chrissy — Hip to-be Single Mom

Chrissy is a 32 year-old single woman. She is a book editor by day and enjoys reading, hiking and going out for dinner with friends and family on her time off. She also spends a lot of time with her sister Maggie and her 9 year-old daughter Rachel.

Chrissy recently switched cell-phone carriers and has a brand new Nokia smart phone. She isn't particularly tech savvy but thought if she got a better model it would last longer, and she hates having to move her information over from one phone to another.

Chrissy has always wanted to have her own children and longs to be a mother. Although she has had some long-term relationships she hasn't found the right guy quite yet.

She decided about a year ago that she was going to have artificial insemination so she could start a family of her own. She has started working with a fertility expert and hopes to be pregnant in the next 9 months.

Although she is working with a fertility expert she would like to have a more hands-on experience in becoming a mother. She recently did a Google search and has found a few software options that will help her track her fertility cycles so she will know more about her own body.

Angelica — 20-Something Wanting to Avoid Pregnancy

Angelica is a 22-year old college senior studying criminal justice at Arizona State University. She would like to be a detective when she graduates. She's dating a psychology student named Mark that she met in one of her classes. She's very concerned about staying in shape and works out every morning. For fun she goes to dance clubs on weekends or plays an occasional game of volleyball.

Angelica has been on birth control for the last 3 years and would like to stop taking “the pill” because of its possible side effects and her family history of strokes. She has her partner wear a condom, but knows that condoms are not 100% effective. She wants to investigate her body’s natural rhythms as an added protection. She doesn’t want to take chances with having a child or facing the decision of an abortion at her age.

Angelica remembers her aunt Mary used some body measurements, something about basal body temperature and graph paper for tracking fertility. She searches on the Internet and reads about basal body temperature tracking, luteinizing hormone tests and cervical mucus examination. She decides that she wants to use luteinizing hormone tests when she estimates she may be close to ovulating. She also measures her basal body temperature every morning before getting out of bed as added confirmation of her body’s schedule.

Angelica feels about as comfortable with technology as many people her age and likes using a few common applications that she finds relevant to her social life and school routine. She has taken an introductory computer class at her school and knows how to use the Web and the Microsoft Office suite. She also checks her email on a daily basis and keeps some connections to friends through MySpace. She uses her mobile phone to record and check her schedule or to-do items, and loves updating her ring tone every couple of weeks to show she knows what is currently popular. She has decided to enter information about her temperature and luteinizing hormone (LH) tests into her phone since she always carries it or has it near her.

Andy & Simone — New Couple Ready to Start a Family

Andy and Simone are in their late 20s and have been married for a year. Andy is a general contractor, having passed his contractor’s licensing exam last year. Simone is an office manager at a landscape architecture company. They rent a house in Vacaville, California, a middle-class suburb about an hour northeast San Francisco. They are in the process of saving money for a down payment on their own home. Even though housing prices are expensive, Andy’s business is really taking off. The real estate market is booming in their area, and that means lots of work for contractors.

Both Andy and Simone have somewhat compulsive personalities, and like to keep the world around them clean and organized. The inside of their house is spotless and their front and back lawns are neatly edged. Even their garage has everything in its place: extension cords are coiled and hang neatly on the walls; boxes labeled “Christmas Decorations” and “Camping Supplies” are stacked neatly in a corner.

The couple wants to have two kids, and is planning for pregnancy in the same way they plan everything else in their lives—carefully and precisely. It’s August now, and they hope to have their first

child in the late spring. That way Simone won't have to suffer through the summer months with a pregnant belly. The couple would also prefer to have a boy first and a girl second.

Simone read that an effective way to plan your pregnancy is by carefully charting your ovulation using kits that you can buy at the drug store. She also read that if you know exactly when you're ovulating, you can time intercourse such that your can favor either a boy or a girl.

Josephina — Pre-menopausal Woman

Josephina is a 42-year-old online retailer through eBay. She makes and sells custom handbags. She has a very supportive husband Reginald who works at the local high school as an algebra teacher.

Josephina has started to notice some changes in her body. Although in her appearance she has aged gracefully, she feels like her body is changing and wonders if she is going through menopause.

She has started to record her fertility as a way of figuring out how her body is changing. She downloaded some software to her computer to help do the math, and create Excel graphs she could save.

Recently Josephina went to her doctor's office. She wished she could have brought the software with her to demonstrate, and relay information to the doctor. Her doctor was also interested in getting the additional information about her patient.

Mark & Mindy — Mature Couple Trying for a Second Child

Mark and Mindy are a married couple in their late 30s who live in the upscale community of La Jolla, California. They have one child, a five-year-daughter named Jordan. They want to have a second. Mindy is 38 and not as fertile as she used to be. Mark and Mindy need to track Mindy's ovulation so they can time their marital relations and maximize the chances that they will conceive. Mindy's gynecologist recommended they try tracking ovulation for six months. If Mindy isn't pregnant by the end of that time, they plan to see a fertility specialist about getting more help. Mark and Mindy are now late into month six of trying to get pregnant a second time.

Mark is a patent lawyer. During the work week, he commutes to his firm's main office in downtown San Diego. Mindy is a stay-at-home mom. They live in a four-bedroom house. He drives a Land Rover and she drives a Volvo station wagon.

Both Mark and Mindy are technologically savvy. Mark performs a lot of research on his computer at work, looking up patents and patent cases. He has a Blackberry handheld for communicating with his coworkers, friends, and Mindy. Mindy spends a lot of time

online researching kid-related subjects. She has a smart phone that she uses to call other mothers, keep a schedule of play dates, and send text messages to Mark. With Mark's busy job, it's often easier to send him text message rather than call.

Mindy volunteers at Jordan's kindergarten once a week, helping the students out with reading. Sometimes she wonders if maybe she should've studied to become a teacher. This amuses her parents, who like to remind Mindy that in her 20s she didn't think she would ever want kids.

Mark and Mindy's sex life isn't as active as it used to be with all the responsibilities and activities that parenthood entails. Mark works long hours; he's trying to make partner at his firm. Mindy spends her days shuttling Jordan to and from school, soccer practice, tumbling lessons, and play dates with her friends. While Jordan is at school, Mindy runs errands and sometimes goes to the gym.

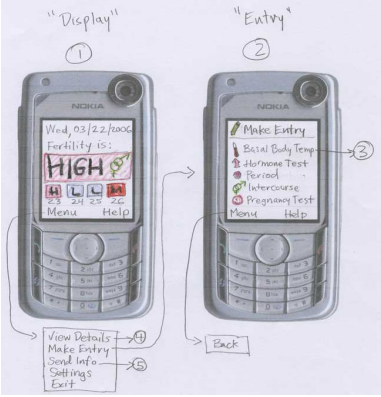
However, trying to have a second child has reinvigorated the romance in their relationship. Now sex is not just an activity to be enjoyed; there's a greater purpose behind it. When tests show that Mindy is ovulating, she sends a text message to Mark on her cell phone: "Eggs for dinner." It's their secret code.

Persona Task Matrix

Recording Tasks	Chrissy	Angelica	Andy & Simone	Josephina	Mark and Mindy
Basal Body Temp	**High**	**High**	**Low**	**High**	**High**
LH Surge	**Med**	**Med**	**High**	**Low**	**High**
Cervical Mucus	**Low**	**Low**	**Low**	**Low**	**Low**
Cycle Info	**High**	**High**	**High**	**High**	**High**
Intercourse	**High**	**Low**	**High**	**Low**	**High**
Prediction Tasks					
Period	**Med**	**High**	**Med**	**Med**	**Med**
Ovulation	**High**	**High**	**High**	**Med**	**High**
Conception	**Low**	**Low**	**High**	**Low**	**High**
Due Date	**Med**	**Low**	**High**	**Low**	**High**
Gender	**Low**	**Low**	**High**	**Low**	**Low**
Output Tasks					
Reminder Alert	**High**	**Med**	**High**	**High**	**High**
Alarm Clock	**High**	**High**	**Low**	**Low**	**Low**
Info Alert	**High**	**Med**	**High**	**Low**	**High**
Results	**Med**	**Med**	**Med**	**Med**	**Med**
Visualization	**High**	**Med**	**Med**	**High**	**Med**
Share Alert	**Low**	**Low**	**High**	**Low**	**High**
Share Results	**Low**	**Low**	**High**	**Low**	**High**
System Tasks					
Configure Alerts	**High**	**High**	**High**	**High**	**High**
Protect Information	**High**	**High**	**High**	**High**	**High**

Prototypes

Preliminary Sketches and Ideas



Based on preliminary research, competitive analysis, and persona development, the team created preliminary sketches for the Health Tracker application. Some of the sketches were created with colored pencils and scanned printouts of a mobile phone. Other sketches were created in an image-editing program.

During this initial stage of design, the team divided the application into four phases: setup, display, entry and sharing.

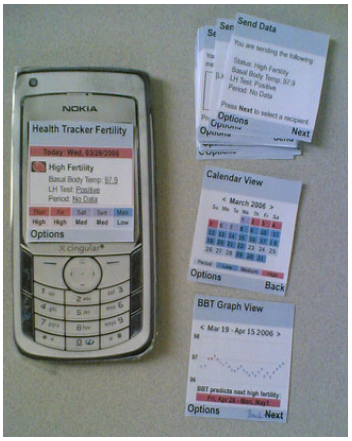
The setup phase would include one-time data entry tasks required to get the system initially running. The data that would be required would first and last day of most recent period, length of cycle in days, and whether to setup alerts or reminders for fertility related tasks.

The display phase would give the Health Tracker user the ability to see what her fertility is for the current day, upcoming week, or upcoming month. The current day screen served as a 'home' screen in the preliminary sketches.

Data entry would be launched from a pop-up menu located on the 'home' screen. Data entry would include separate screens for basal body temperature, lutenizing hormone tests, and period information.

Preliminary sketches gave the group visual grounding for discussion about how to proceed with the first paper prototype.

Paper Prototype I



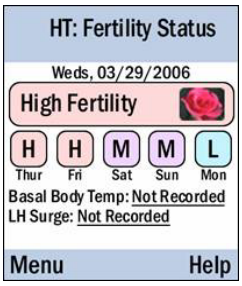
Setup

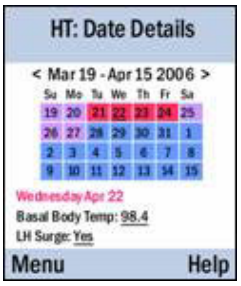
The first paper prototype test required the tester to walk through different Health Tracker screens talking aloud about what they would be doing, and raising any questions they had about the interface. The testing involved paper cutouts of screens placed atop a 2x-scale foam-core phone. During testing of the first paper prototype, we wanted to find out:

1. Do the users understand the elements visual elements on the Main and Details screens?
2. Do they understand how to enter basic fertility data on the phone?
3. Can they navigate through the setup "wizard" to enter preliminary information and preferences?

For this paper prototype test the team interviewed four women between the age of 25 and 39**.** None of the participants had tracked their fertility before; all had used at least basic mobile phone functions.

	Participant 1	Participant 2	Participant 3	Participant 4
Approximate Age	20s	30s	40s	30s
Occupation	Student	Student	Student	Student
Uses Mobile Phone	Yes	Yes	Yes	Yes
Tracked Fertility or Ovulation	No	No	No	No
Uses Advanced Mobile Apps	No	No	No	Yes
Has Children	No	No	No	Yes





Tasks

In task 1, participants were asked to walk through the setup wizard for Health Tracker. This setup consisted of sixteen entry screens that asked if the user wanted to track her fertility with either of the two available methods (BBT and LH testing). It then asked if the user would like to be reminded to record the test information. If the participants answered yes, they were taken to a screen where she could set up alarm reminders for specific times of the day.

Task 2 asked the user to look at the current home screen and explain what they thought each of the elements on the screen meant or what function it performed. The goal of this task was to see if the large amount of information that was being displayed on the screen was clear to users and if they knew that the underlined words “Not Recorded” behind “Basal Body Temp” and “LH Surge” were clickable items that enabled data entry.

Task 3 asked the user to imagine she had just woken up and had taken her own temperature before leaving her bed. After getting a reading from the digital thermometer, the user picks up her mobile phone to find the Health Tracker home screen. The user was instructed to enter their basal body temperature. The group wanted to learn if the user knew how to navigate to the link on the mobile phone screen, if she searched for a data entry option in the menu, or if she just tried to type a number in directly without searching for a prompt.

Task 4 was designed to test the data visualization screens. During the test the user was prompted that she had been recording her basal body temperature and LH levels for about a month and she would like to see an overview of her entries. The team observed which selection the participant chose first as well as what was understandable and what was not when they arrived at the calendar and graph screens.

Feedback

The team learned several lessons during this phase of paper prototype testing. The first lesson learned was that users were fairly unfamiliar with using links in the context of mobile phones. In general the links did not express that they were actionable items that moved the user to another screen, even though they are the standard on computer-based web pages.

The second lesson learned was that the data readout sections in the calendar and graph views were not coupled closely enough with the visualization. It wasn't obvious to our testers that as they moved through the data fields on the display screens that the related data would change at the bottom of the screen.

The third lesson was that our initial calendar screen, which could display any given four-week time period and could span two adjacent months, did not make sense to users. If we wanted to make the interface understandable, we needed to represent a month in a more familiar way, with an entire month being displayed on the screen at a time.

The fourth lesson we learned was that color is subjective and different users wanted to represent, high, medium, low fertility states with different color schemes.

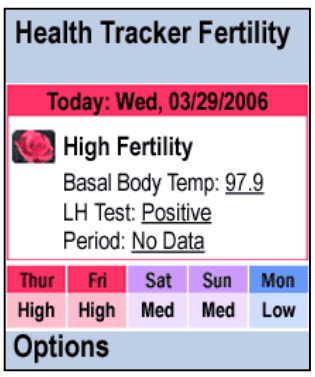
The last and most important lesson we learned in our first prototype session was that most of the women who were participating in our study did not know about their own fertility. Most did not ask questions of the team. One pointed out that she would have asked friends or family about the information. It was mentioned that it would have been nice to have had a paper brochure to read before the test to learn about the different types of fertility measurements. The paper brochure would also be helpful because it could be referred to during application setup.

Reactions

All of the feedback that was given to the team was incorporated into the next iteration of the paper prototype. The interface needed to depend more on standard phone interface elements and not to borrow as much from web conventions.

Some of the designs that the team considered for the second prototype included a comic-style callout box that would couple information displayed at the bottom to the selected date in the calendar or graph.

The team also decided it would be interesting to provide a palette of choices for color selection. This was formulated using standard color pallets provided by a major software application (Microsoft Publisher). Each of the selected pallets was also checked online for red-green and blue-yellow color blindness compliance. Each of the selected palettes provides three distinct shades for fully colorblind individuals.



An original brochure was also created to help inform participants about relevant fertility vocabulary.

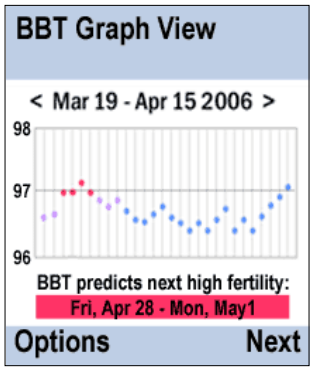
Paper Prototype II

Setup

The second round of paper prototyping included three test participants, all female between the ages of 25 and 35. One of the participants in this test group was a new mother. This iteration

would discover whether the changes made since the first prototype made sense to users before moving on to more in-depth prototypes.

	Participant 1	Participant 2	Participant 3
Approximate Age	30s	20s	30s
Occupation	Student	Student	Student
Uses Mobile Phone	Yes	Yes	Yes
Has Children	No	No	Yes



Tasks

The first task asked the user to read the brochure that was created as a result of the first paper prototype tests. The goal of this task was to assess the understandability of the brochure. Participants were asked the following questions:

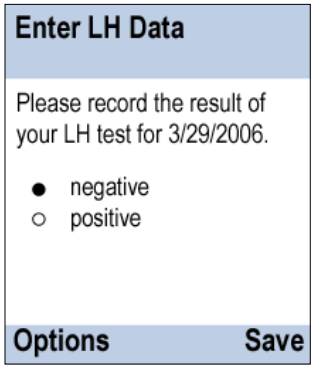
- What is basal body temperature (BBT) and how would you go about measuring it
- Why would you measure BBT?
- What change takes place in luteinizing hormone as a woman is ovulating?
- Would you know where to obtain an LH test to use with this software?

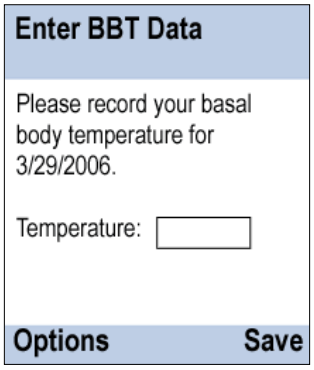
Task 2 asked the user to pretend they were a new Health Tracker user who was configuring the system for the first time. This took them through the redesigned multi-step setup wizard. The goal of this task was to see if the changes made since the first paper prototype improved the interface's usability.

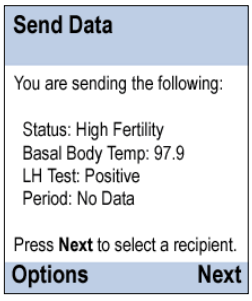
Task 3 presented the user with the Health Tracker home screen and asked her to pretend to enter her Basal Body Temperature after waking up in the morning. It also asked the participant to reflect on the information that was being displayed on the home screen and to report what she thought their fertility would be for the next few days. The goal of this task was to see if the changes to the data entry screen made the task easier for the user. It also checked to make sure the 'five-day forecast' style of fertility prediction on the homepage was clear to another set of testers

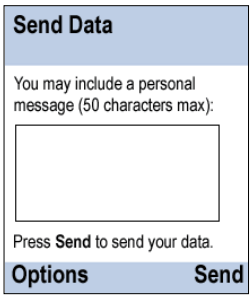
Task 4 informed the participant that she had been using Health Tracker for at least a month. It asked her to look at an overview of her fertility data. This was included to test the new layout and design.

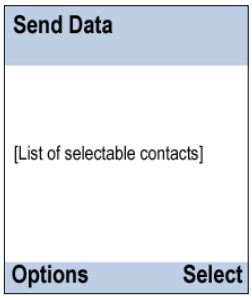
Task 5 asked the user to look ahead in their cycle to plan a getaway weekend with her husband. This task forced the user to look at the calendar view. The goal was to make sure the standard calendar layout was more understandable than the previous four-week view. It also tested whether the new simplified view offered enough information for the user to make a decision.

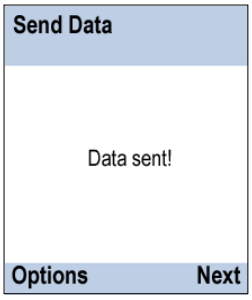












Task 6 requested the user to enter a fake LH reading and then send the data to a contact. The goal of this task was to test the input screen for the LH test. It also tested new functionality enabling a user to send fertility information to another person via a text message.

Feedback

In addition to testing the changes made based on the first paper prototype, the team learned other valuable lessons about interaction, screen layout, and user predictability.

Although we provided our testers with the Health Tracker informational brochure before we tested them with the interface, some did not read it completely, since they still had questions and did not understand some abbreviations such as LH which was spelled out in depth in the brochure. We assumed people would refer back to the brochure if they had questions during setup, but this did not happen.

The new calendar view with the standard month layout enabled users to better understand what was being represented compared to the previous test. Users reported that they were satisfied not having any of the detail information that was included in the last prototype. Some comments: “I just wanted to see the pattern.” “I like the colors. I can see patterns at a glance.” “I don’t think I’d ever want the details from a month ago.” “I don’t think I’d want to dive into the details”

It was brought up again during the tests, especially regarding the calendar view and main screens, that color is a personal choice. During this test we asked users to identify a color palette that they liked and thought they may choose for the interface. Having this choice was well received.

Because the main screen in Health Tracker is a jumping off point for all functionality, the team spent some time between the first prototype test and the second updating and tweaking the interface. In general users understood the ‘five-day forecast’ and appreciated its familiar television-like treatment. Users could identify all of the elements on the main screen and describe what each element did. The links were still a mystery and it was suggested that if we could get all of the data entry on one screen that would be useful to users. (See Appendix G for supporting materials.)

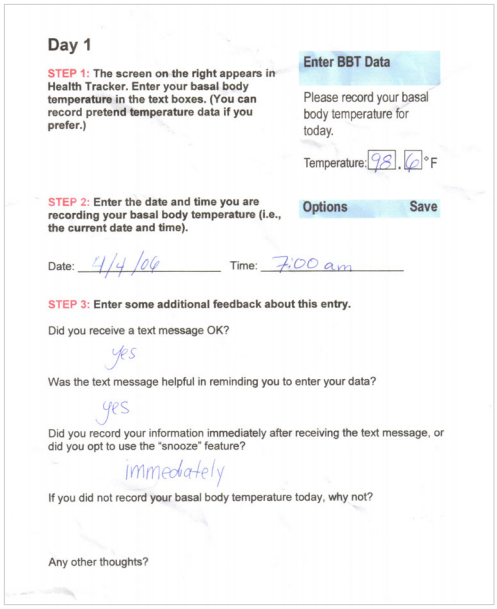
Reactions

This paper prototype test helped us solidify the design of all the screens prior to interactive prototyping.

For the data entry tasks during this testing, most of our users could not imagine how they would interact using the keys provided by the phone. This meant that the team really needed to get an interactive prototype working that at least emulated the phone to test what people would do if they couldn’t pretend to click with their finger.

Week-Long Reminder Study

Setup


Day 1

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)

Enter BBT Data

Please record your basal body temperature for today.

Temperature: 98.6 °F

STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Options Save

Date: 4/4/06 Time: 7:00 am

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

yes

Was the text message helpful in reminding you to enter your data?

yes

Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

immediately

If you did not record your basal body temperature today, why not?

Any other thoughts?

An advantage a mobile phone-based diary has over a paper diary is that it can actively remind a user to take action. We included a reminder system in the Health Tracker design that could alert users to take their basal body temperature or complete an LH (ovulation) test at the appropriate time. We designed a week-long user test to evaluate the utility and convenience of such a reminder system.

We recruited three users to receive daily reminders on their mobile phones for seven straight days. We simulated Health Tracker reminders for basal body temperature by sending each user a daily text message at the time when they would normally wake up.

After receiving a text-message reminder, the user would fill in a one-page form. Each form included a screen shot along with several questions about any difficulties the users had receiving or responding to the alerts.

The users had the option of pressing a pretend "snooze" button and fill out the form later in the day, if for some reason taking their temperature and filling out the form was inconvenient at the time the alert was received. The users could either take their actual temperature and fill in real information or fill in made-up information.

	Participant 1	**Participant 2**	**Participant 3**
Approximate Age	40s	30s	20s
Occupation	Student	Student	Student
Mobile Phone Uses	Contact List Text Messaging	Contact List, Notepad, Text Messaging Camera Internet	Contact List Alarms
Paper Journaling History	Fitness tracking, weight management	TV and radio consumption practices	Mood, Migraine tracking

Feedback

Past and current practice is important. The team assumed that our participants kept their phone on and with them all the time, including when they were sleeping. The assumptions turned out not to be true for two of our participants. They often left the phone

in a bag or in another room. One participant sometimes did not get the reminder and would forget to fill in the entry for the day.

Another issue that affected all participants was the variability in their wake up times. In some cases, participants got up earlier than their alarms. Participants would sometimes get up earlier and engage in some activity before remembering to take her temperature. This pattern would affect the accuracy of any BBT readings for that day since BBT needs to be recorded upon waking.

All the participants liked the idea of being reminded to do something that was important and said they would use such a feature if given the choice. Every participant missed filling in data at least one day during the week. Despite the lapses, the reminders were helpful to them at least some of the time. The reminders also helped them to get in the habit of recording information.

All of the participants understood the utility of entering fertility information on the phone, since it was a device that could be carried around all the time and taken on vacations, business trips or other away-from-home activities. (See Appendix H for supporting materials.)

Reactions

Considering past practice is important. It is possible that a user may want to write down her fertility information on a piece of paper and enter it in later in the day or retroactively at the end of a week. Participants may or may not want reminders popping up on specific days or altogether.

Since they were not actually trying to track their fertility, the users did not have an internal motivation (other than to help us out) to change their current practices with their mobile phone. They did not have the burning motivation to record their fertility information accurately in order to become pregnant or avoid pregnancy. The testing was useful, but we would expect slightly different results from those who were more seriously tracking their fertility.

If this had been a longer-term study, it would have been better to recruit women who were trying to get pregnant and already were tracking their fertility, Perhaps we could provide software and hardware they needed in order to see if they preferred recording their fertility on a phone over recording it on paper. This would ensure the participants were already in the journaling habit and had the appropriate goals and motivation.

Interactive Prototype

Setup

During the interactive prototype testing, we were able to explore what it was like to use Health Tracker on a mobile device. The

team started development of the final electronic prototype using Python on Symbian Series 60 phones. Although Python is much easier than other programming languages for the phone, it did not deliver the correct look and feel for the design we were after. The team decided to commit to developing our proof of concept design using Flash Lite. The team does not imagine that a final release version of the interface would be designed in Flash, but would be created with a more robust low-level programming language.

	Participant 1	**Participant 2**	**Participant 3**
Approximate Age	30s	20s	30s
Occupation	Student	Student	Student
Uses Mobile Phone	Just voice	Voice Calls, Text Messaging	Voice Calls, Alarm Clock
Has Children	Exercise	No	Financial Diary

Tasks

Task 1 prompted the user to look ahead in her cycle to plan a getaway weekend with her husband. This task forced the user to look at the calendar view. The goal was to make sure the standard calendar layout was more understandable than the previous four week view, and also that the simplified view was enough information for the user to make an informed decision.

Task 2 allowed the user to look back on her temperature recordings from the last two months to see how temperature mapped with the Health Tracker fertility predictions. The goal of the task was to see if the participant could understand and interpret the graph visualization.

Task 3 asked the user to enter Basal Body Temperature they had recorded on a piece of paper earlier in the day. The task also informed the participant it was the first day of her period.

Feedback

In the graph view, users had comments about navigating both within the graph as well as between months. It wasn't clear to them that they could move to different points using the joystick. They also wanted selectable arrows to move between months.

There were some color issues with the graph view. One user said the purple dots were hard to distinguish while another one had a hard time distinguishing the blue from the purple. The users generally thought that the red dots stood out well.

Moving to different days in the calendar using the joystick and selecting a day to view its details made sense to the users.

Regarding the backup function, one user suggested being able to send the data to a PC via a Bluetooth connection. Another user

mentioned having instructions somewhere on how to get the data onto another phone. These were features we wouldn't have time to pursue.

One of the users had extra testing time, so we had here complete the setup wizard. She mentioned some of the screens were wordy. She also suggested combining the BBT and LH reminders into a single reminder. It didn't make sense to her that she would receive those reminders separately on a given day.

Reactions

Running Health Tracker on a PC-based emulator was useful in that it gave our testers a clickable phone-like environment, although the mapping between the mouse and the screen turned out to be confusing. Some of our testers were not mobile-phone application users, so they did not know how to access certain elements. They had to experiment with the interface. In the end, all of the users figured out what buttons to press in the emulator to complete the tasks.

We think the issues some of the users had moving within the graph view were partly because the graph view wasn't fully functional. The popup temperature reading wasn't implemented, nor was the calendar day at the bottom of the graph. We think that if those features had been present, the interaction would've been more obvious. We did add arrows to the left and right of the month titles—in both the graph and calendar views—to allow for navigation between months, as suggested by the users.

To resolve the color issues on the graph, we lightened the gray grid lines so that they didn't compete as much with the points. This helped the points stand out more.

The suggestion about combining BBT and LH reminders was an interesting one. If we had time, we could explore this using another real-world test of the reminder system.

Final On-Phone Prototype

The on-phone prototype is a version of the software that we designed for demonstrating the interface, interaction, and screen flow concepts on a mobile phone. We designed the on-phone version after completing the tests of our interactive prototype, which ran in a PC-based phone emulator.

The interface is not intended to be a fully functional version of the software with all information dynamically generated. Creating a fully functional and completely dynamic version of the prototype was not the focus of our project. Instead we focused on using iterations of prototyping and testing to obtain a good interface and interaction design. We added some dynamic elements to the most frequently encountered screens to give a feel for how things would

work. We made most screens interactive so that users could choose options and enter data on them.

We created the prototype using Flash Lite 2.0 since it is one of the few technologies we found that can currently create a mobile phone prototype rapidly and still mostly maintain high-fidelity interface concepts and interaction.

On-Phone Prototype Technology

We chose to use Flash Lite in creating our final interactive prototype because it allowed us to create a high-fidelity prototype quickly and with reasonable effort. It seemed the most realistic technology to use based on our skill set. It also was a better fit for the interface testing and demonstration goals we had. Some technologies we considered were.

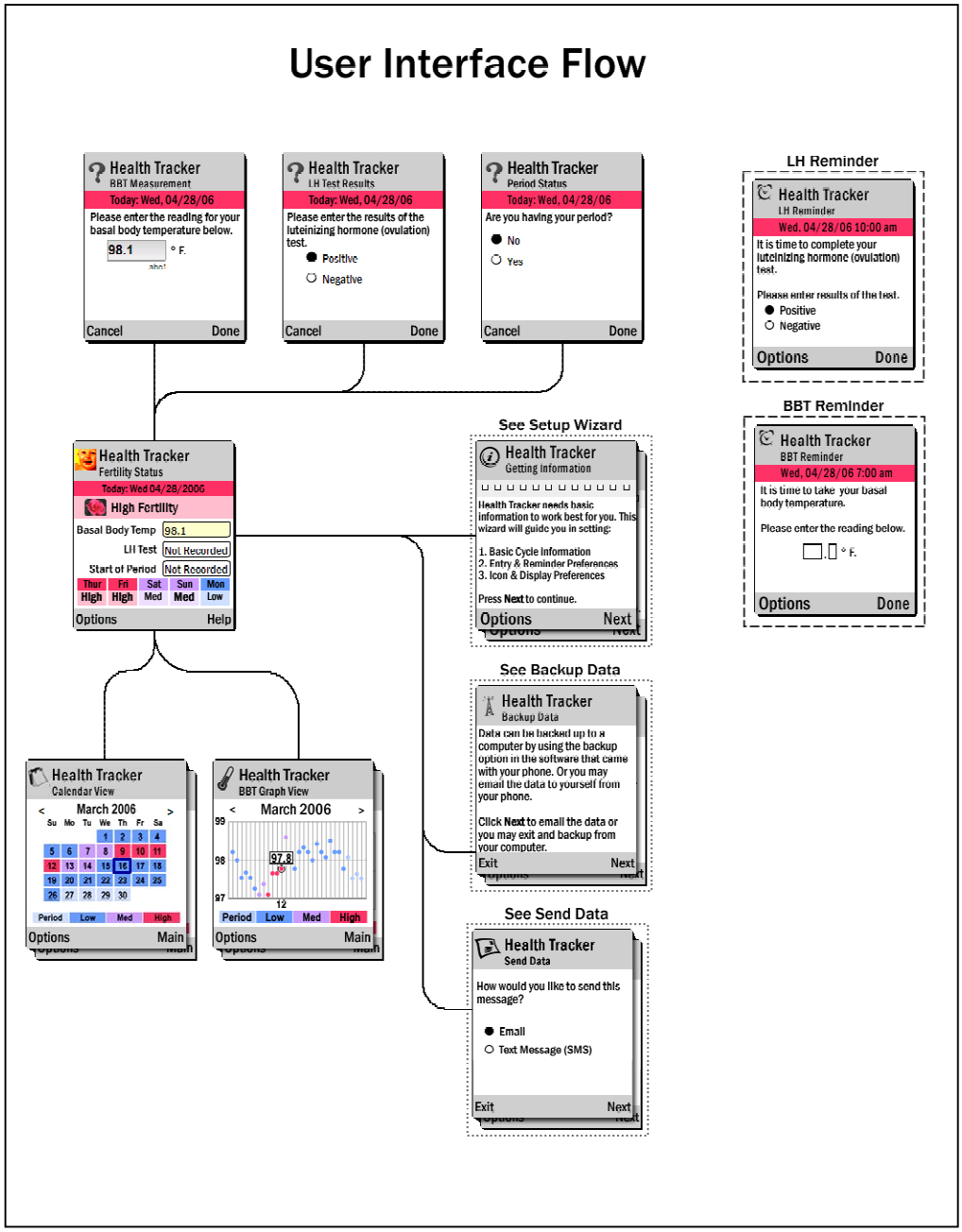
- **Symbian** (native programming) allows more low level access to functionality on the Nokia phones that were available. Code is written using C++ with special libraries and techniques. While it can create nicely-functioning software, it is much more complicated to program than most other technologies. Development times would have been unrealistically long for the timeframe of our project. No one in our group was familiar with the technologies.
- **J2ME** creates less of a barrier than Symbian since it requires less low-level programming. GUI creation was still less simple than some other technologies. Java was known by all members of our group so it presented some attractive aspects and would've likely been the best alternate choice to using Flash Lite.
- **Python** presented a relatively quick route for developing phone applications, but did not allow us to preserve many of our design concepts with any degree of fidelity. One person in our group felt comfortable using it. We did not want to lose much of our interface design because of technology limitations.
- **Pocket PC** programming offered many things we were looking for since it has good visual GUI creation tools in Microsoft Visual Studio (with program code in C# or VB.NET). Disadvantages were that it did not target the mobile phone platform and we did not have access to Pocket PC devices. Further, only one group member was familiar with the technologies and owned Visual Studio.NET.
- **Flash Lite** offered good rapid prototyping capabilities for GUIs. Two of the three group members had used Flash before and all three of the group members had the Macromedia (now Adobe) suite of products that includes the Flash development environment.

Flash Lite turned out to be a useful tool, but we discovered a few unforeseen drawbacks. Some programs would not run in on the phone but would only run on the emulator included with Flash. In order to get them running on the phone the code had to be simplified and rewritten.

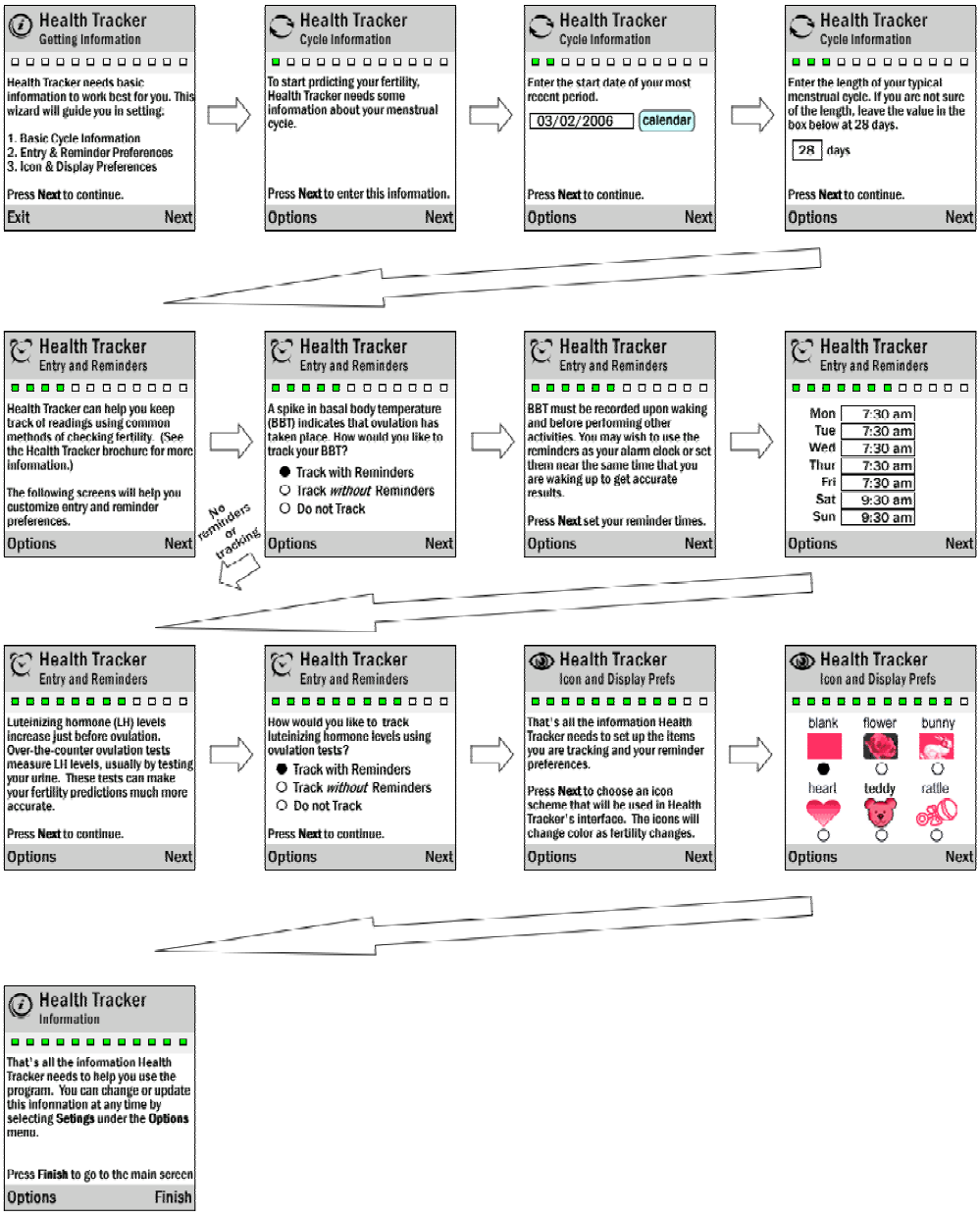
Certain widgets acted unexpectedly on the phone. For instance the text box would not allow direct entry of text but made the user press the enter button to get a pop-up screen in order to enter text. Access order for controls was hard to accomplish and tab order did not always work as specified.

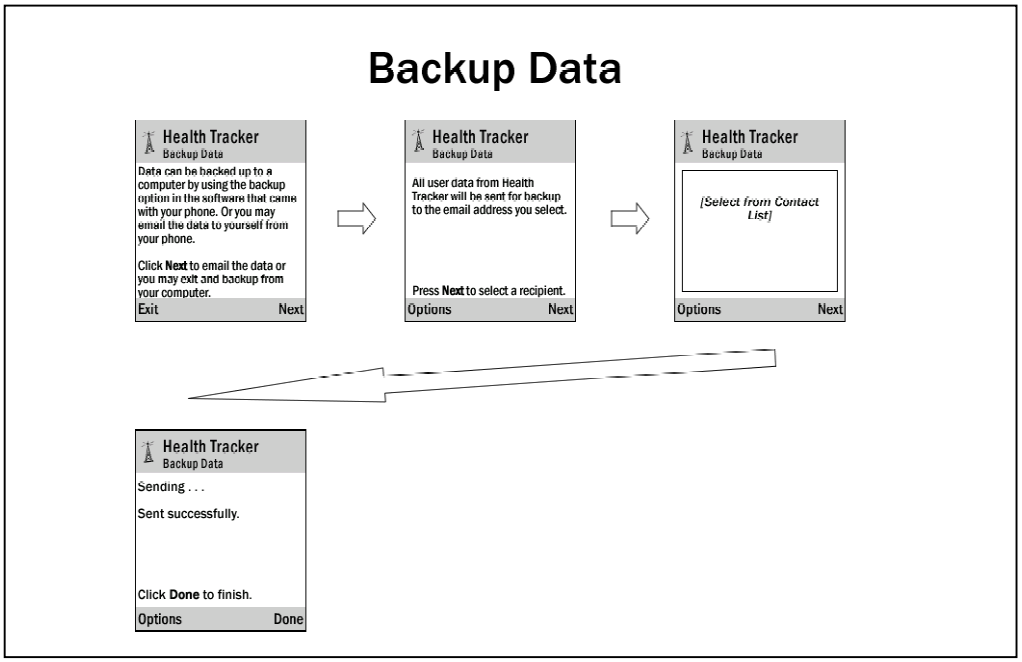
Despite the drawbacks Flash Lite still seems the most reasonable choice for our goals and objectives in creating the on-phone prototype for testing.

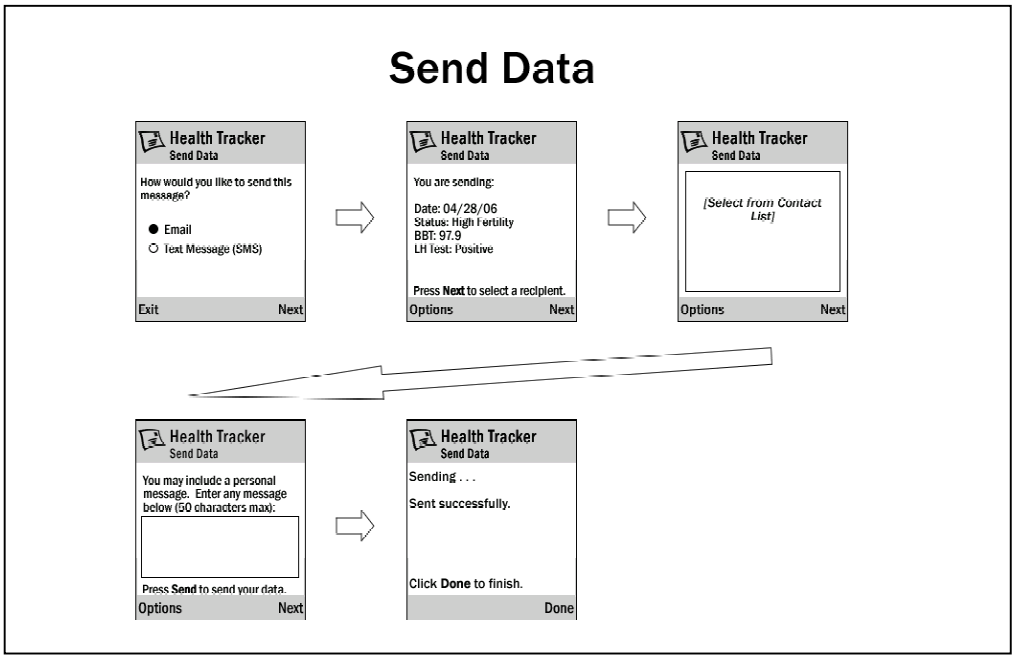
User Interface Flow Diagrams



Setup Wizard



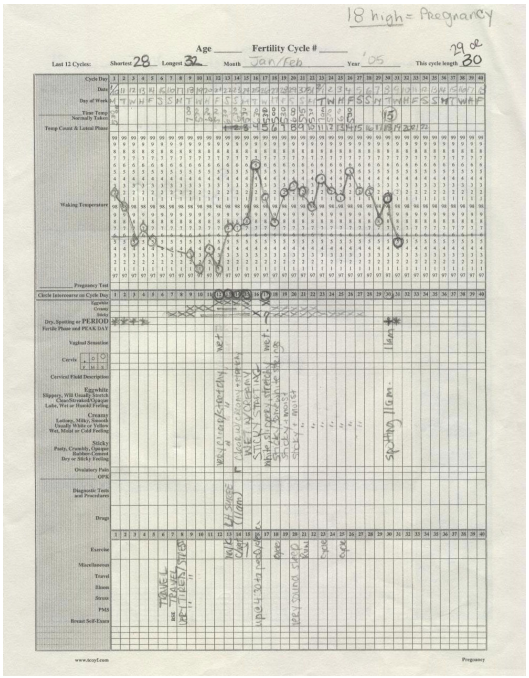




Discussion and Analysis

What the Project Borrowed

Our background research, which included a literature review, interviews with diary keepers, and an analysis of related products, provided us with various conventions and design patterns that we could draw on to create a fertility tracking system.



From Fertility Products

The Health Tracker graph view, which displays past basal body temperature information, is modeled after the traditional paper-based temperature graphs that women trying to conceive fill out by hand. To optimize the graph for use on a phone, we eliminated extraneous information and made the graph interactive, allowing the user to view specific measurements for one plot point at a time.

The calendar view borrows conventions from other standard calendaring applications, encoding various days using a colored fill within a specific day. This method of visualization was used in other PC-based fertility software application, including “Taking Charge of Your Fertility” which is analyzed further in Analysis of Related Products on page 13.

We borrowed the fertility-status color scheme from many fertility and pregnancy products. Fertility tracking systems often use pink or red to denote high fertility and blue to denote low fertility. Pregnancy products use pink and blue because the colors are associated with girl and boy babies, respectively. For accessibility, we selected colors (dark pink, lavender, blue, light blue) that had different enough tones to be distinguishable by someone who was colorblind.

From Other Sources

The five-day forecast displayed on the bottom of the main screen borrows from the standard weather forecast boxes seen on television news programs and Web sites such as Weather.com. Most of our testers immediately understood what the forecast boxes on the main screen were communicating.

The sequence of Health Tracker setup screens borrows from the setup “wizards” that are universally seen in software applications.

Conventions from Nokia Symbian Series 60 mobile phones were used to ensure consistency with standard mobile applications. For example, we ended up removing the drop-down menus from our initial Flash-based prototype after discovering that they were almost impossible to work with given the user input model on Nokia mobile phones.

What the Project Innovated

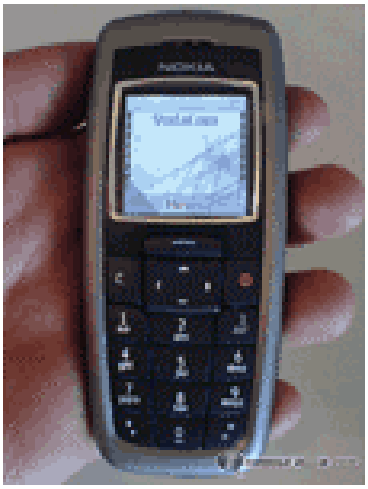
Redesigning Fertility Tracking to Work on a Phone

Most fertility software and journaling techniques involve basal body temperature recording, with the results presented in graph format. This graph view enables a woman to see trends in her fertility over time, which helps them predict when they will be fertile again.

Because mobile phones have a restricted amount of screen real-estate, a standard graph view could not be employed. Instead the group created an interactive graph view. The user can see the trend of data over time and as she presses the right or left arrow

key on the phone four-way navigation device she moves through the days on the graph viewing the specific details only for the selected day. This selection-plus-context scheme gives the best of two worlds.

Health Tracker's calendar view represents a simplified calendar design, only displaying fertility status. This decision was made based on research, interview and usability analysis. The essential information that was required from the calendar was its ability to show past and future data in a format that allowed a human to plan ahead based relevant fertility data.



Leveraging the Strengths of Mobile Devices

As we learned in our background research, one of the most difficult aspects of diary keeping is remembering to make entries. Health Tracker helps remedy this problem by actively reminding the users to take and enter results from their fertility tests. Users can set up reminders for both basal body temperature measurement and ovulation testing. Our real-world user tests of the reminder system showed that testers thought this feature was a helpful.

Mobile phones are by design communicative devices. Not only are they used for voice communication, many allow people to send text messages and e-mail messages to their friends and family. Most of today's newer phones allow the user to send data via text message or e-mail. We realized that this could be helpful for users who wanted to share fertility information with their partner or healthcare provider. The "Send Data" feature allows users to send the current day's information via text message or e-mail to anyone in their contact list.

Creating an Easy-to-Use Main Screen

Through several design iterations, we crafted a main screen that our testers could quickly and unambiguously interpret. This is critical, since the main screen serves as Health Tracker's central navigation point and jumping-off point for the different features.

The Main Screen Includes:

- The current day's fertility status using color, text, and a customizable icon.
- BBT test, LH test, or period information
- Fertility status for upcoming days using a row of forecast boxes.

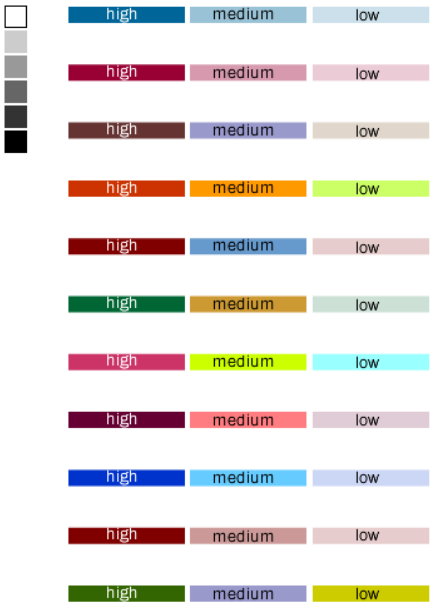
Design Challenges

We faced a number of design challenges during the development of Health Tracker, some related to mobile phones and others related to fertility concepts.

Working within the confines of a small screen

The screen of the phone is small, making it hard to fit a lot of information. For example, the screen on a Nokia Series 60 phone is 176 pixels wide by 208 pixels tall. From the outset, we tried to

take the limited screen real estate into account. Many of our initial designs were sketched using a scan of an actual phone. Later versions created also included the standard Nokia header and footer.



Predicting color preferences

Since we wanted people to be able to understand their current fertility status with a quick glance at their phones, we needed to choose colors that were recognizable as meaning “high fertility” or “low fertility.” Everyone seemed to have a different opinion on which colors were best—even the three team members were in disagreement. We decided to follow conventions seen in other fertility applications: pink for high fertility and blue for low fertility. This choice was well-received by our users, although some users suggested the green/yellow/red stoplight colors as an alternative. We came up with a variety of other palettes that could be integrated into the setup screens if we wanted to offer users custom colors.

Meaningful Iconography

Creating meaningful iconography is a difficult task. During our preliminary user tests, the team asked participants what icon they would like to represent the current fertility status. The answers never converged in a meaningful way. The group decided to allow users to select the icon from several presented during setup. We found that this choice was appreciated by our testers.

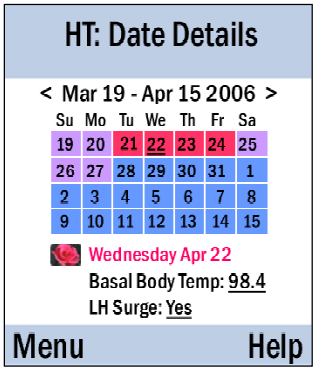
The “Web bias” of our user test participants

While all of our testers had mobile phones, few of them had experience beyond making and receiving calls and text messaging. They did have a lot of experience with the Web, so they were used to pointing and clicking with a mouse to interact. When we saw users pointing and clicking with their fingers during tests of the paper prototypes, we would remind them that they were using a phone and not a PC with a mouse. When evaluating user suggestions after a test, we needed to consider a possible Web-related bias. For instance, several of our users said they’d prefer to enter all of their fertility testing data on the main screen. While this strategy might work well on a Web page, where a user could easily click between different menus or text-entry fields, it turned out to be impossible on a phone where using compact items such as drop-down lists proved to be confusing. It was better to design separate screens for each type of data entry.

Addressing technical terminology

As is the case with most health topics, fertility has its own set of technical terminology. Terminology was problematic since many of the participants in our user tests had not tracked their fertility before. During the initial user tests, two of the participants suggested we create an informational brochure about fertility.

The Health Tracker software solution includes a six-page handout that users can review through before using the application. Real-world users can keep the brochure handy if they ever have



questions about fertility terminology or software functionality. Recognizing that in the real world not everyone would read the brochure, we also added more explanation on the setup screens that appeared the first time Health Tracker was started.

Lessons Learned

Follow Convention

People are often confused if you take a very familiar metaphor and change it so that it works in a slightly different way. For example, in the first prototype we experimented with having a calendar view that would then show different information in a different part of the screen depending on what day was selected. People found this design confusing.

We also found examining the current interface standards for existing mobile products useful since other designers may have encountered and overcome some of the same problems we were encountering. The drop-down confusion mentioned above illustrates a good example of this point. If we had examined the Nokia applications we would probably have noticed sooner that Nokia *never* uses a drop-down list in any of its applications. We assumed they discovered the difficulty with these kinds of controls and do not use them.

Explicit Instructions

Explicit instructions about how to proceed were useful since people are often unsure how to interact with a mobile interface. Often people were confused about how to go to the next screen or perform actions. When they were given specific instructions about how to navigate, they seemed to have an easier time working thorough the tasks and commented positively on the instructions.

Fill in Necessary Background

Many of our testers were confused by fertility terminology and did not understand the process involved. Some confusion and uncertainty was present even in cases in which people had previous experience. After the first prototype, we created a brochure to give people some background about the process. Participants had an overwhelmingly positive response to the brochure since it was able to supplement the limited space offered by the mobile platform.

Limitations of Paper Prototypes

During paper prototype testing, a number of people suggested that all of our selection options should be on the main screen using compact items such as drop-down lists. In the next iteration we changed our interface to use drop-down lists to allow users to enter the information in one screen. When people went to use multi-function home screen, it became very confusing to figure out what directional buttons would open or change the drop-down menus and which directional buttons would move to the next control on the screen.

Your Users Are Not You

During our week-long study we learned that we had made some general assumptions about mobile phone use that were not correct for all of our testers. We assumed that most people left their mobile phones on at night, and near them at all times. It turned out that this was not the case and we needed to design for people who may not receive a reminder on their phone as part of their waking process.

Future Directions

Since we had a limited time frame and resources, we were not able to complete a fully functioning product in the time frame. The limitations of the prototype were intentional since we chose to focus on testing and evaluating the interface by iterations of creation, testing, and modification. There were a number of things we would do in the future if we continued work on the product.

We would like to make the application better at displaying dynamic data such as the calendar screens. Currently we have a fixed set of screens that suffice for interface testing but would not be useful for an actual user in a real world situation. We would need to use some other technology besides Flash Lite to prototype a fully functioning version.

If the project was pursued in the future, it would make sense to create a general framework for journal applications so that many journal and reminder systems could be easily created. A general journal application might resemble something such as survey applications that make it easy to create many types of surveys without programming each individually. Although such a system would be complicated to build, it is likely to be valuable and save effort for people needing to create an array of similar yet diverse systems in the future.

Another future direction would be to update the design so that it was practical for doctors, nurses, and other healthcare providers. Early on, we decided to concentrate our efforts on the patient in order to keep the scope of the project manageable. Extending the system to work well for healthcare providers could involve having the user enter more medically significant data or designing visualizations that support medical decision making.

Bibliography

Aaron, L. A., et al. "Reasons for Missing Interviews in the Daily Electronic Assessment of Pain, Mood, and Stress." Pain 109.3 (2004): 389-98.

Aboud, Mynatt. "Charting Past, Present, and Future Research in Ubiquitous Computing." ACM Transactions on Computer-Human Interaction 7.1 (2000): 29-58.

Anhøj, J., et al. "Feasibility of Collecting Diary Data from Asthma Patients through Mobile Phones and SMS (Short Message Service): Response Rate Analysis and Focus Group Evaluation from a Pilot Study." Journal of Medical Internet Research 6.4

Banitsas, K. A., et al. "Using Handheld Devices for Real-Time Wireless Teleconsultation." Engineering in Medicine and Biology Society, 2004.

Behre, H. M. "Prediction of Ovulation by Urinary Hormone Measurements with the Home use ClearPlan Fertility Monitor: Comparison with Transvaginal Ultrasound Scans and Serum Hormone Measurements." Human Reproduction 15.12 (2000): 2478-82.

Bielli, E., et al. "A Wireless Health Outcomes Monitoring System (WHOMS): Development and Field Testing with Cancer Patients using Mobile Phones." BMC Medical Informatics and Decision Making 2004.4 (2004): 7.

Bodenheimer, T., and K. Grumbach. "A Spark to Revitalize Primary Care?" JAMA 290 (2003): 259-64.

Bolger, N., A. Davis, and E. Rafaeli. "Diary Methods: Capturing Life as it is Lived." Annual Review of Psychology 54 (2003): 579-616.

Carroll, Christakis. “Pediatricians' Use of and Attitudes about Personal Digital Assistants.” Vol. 113., 2004.

Chen, E. S., et al. "PalmCIS: A Wireless Handheld Application for Satisfying Clinician Information Needs." J Am Med Inform Assoc 11 (2004): 19-28.

Collins, R. L., T. B. Kashdan, and G. Gollnisch. "The Feasibility of using Cellular Phones to Collect Ecological Momentary Assessment Data: Application to Alcohol Consumption." Experimental and clinical psychopharmacology 11.1 (2003): 73-8.

Connelly, K. H., et al. "Designing a PDA Interface for Dialysis Patients to Monitor Diet in their Everyday Life." HCI-International, Las Vegas, NV (2005)

DeCherney, A. H., and G. S. Berkowitz. "Female Fecundity and Age." N Engl J Med 306.7 (1982): 424-6.

De Groote, S. L., and M. Doranski. "The use of Personal Digital Assistants in the Health Sciences: Results of a Survey." J Med Libr Assoc 92.3 (2004): 341–349.

Fehring, R. J. "New Low-and High-Tech Calendar Methods of Family Planning." J Midwifery Womens Health 50.1 (2005): 31-8.

Fischer, S., et al. "Handheld Computing in Medicine." J Am Med Inform Assoc 10.2 (2003): 139-49.

Forkner-Dunn, J. "Internet-Based Patient Self-Care: The Next Generation of Health Care Delivery." J Med Internet Res 5.2 (2003): e8.

Fox, S., and L. Rainie. The Online Health Care Revolution: How the Web Helps Americans Take Better Care of Themselves. Pew Internet & American Life Project, 2000.

Hauser, S. E., et al. "PubMed on Tap: Discovering Design Principles for Online Information Delivery to Handheld Computers." Submitted to: 11th World Congress on Medical Informatics (2004): 7-11.

Home, J., et al. "Internet-Based Patient Self-Care: The Next Generation of Health Care Delivery." J Med Internet Res 5.2 (2003): e8.

Hufford, M. R., et al. "Paper Vs. Electronic Diaries: Compliance and Subject Evaluations." Applied Clinical Trials (2002): 38-43.

Johannes, C., et al. "Electronic Versus Paper Instruments for Daily Data Collection." Ann Epidemiol 10.7 (2000): 457.

Johannes, C. B., et al. "An Electronic Menstrual Cycle Calendar: Comparison of Data Quality with a Paper Version." Menopause 7.3 (2000): 200-8.

Katz, S. J., and C. A. Moyer. "The Emerging Role of Online Communication between Patients and their Providers." Journal of General Internal Medicine 19.9 (2004): 978-83.

Koop, A., and R. Mosges. "The use of Handheld Computers in Clinical Trials." Control Clin Trials 23.5 (2002): 469-80.

Kreindler, D., et al. "Portable Moodmapping: The Validity And Reliability of Analog Scale Displays for Mood Assessment Via Hand-Held Computer." Psychiatry Research 120 (2003): 165.

Kyriacou, E., et al. "Multi-Purpose HealthCare Telemedicine Systems with Mobile Communication Link Support." BioMedical Engineering OnLine 2003.2 (2003): 7.

Laurier, E. "Why People Say Where they are during Mobile Phone Calls." Environment and Planning D: Society & Space 19.4 (2001): 485-504.

Li, Y.C. “The Critical Factors Affecting Hospital Adoption of Mobile Nursing Technologies in Taiwan.” Proceedings of the 38th Annual Hawaii International Conference on System Sciences (2005).

Liederman, E. M., and C. S. Morefield. "Web Messaging: A New Tool for Patient-Physician Communication." J Am Med Inform Assoc 10.3 (2003): 260-70.

McAlearney, A. S., S. B. Schweikhart, and M. A. Medow. "Doctors' Experience with Handheld Computers in Clinical Practice: Qualitative Study." Br Med J 328 (2004): 1162.

Mendonca, Chen, Stetson, McKnight, Lei,Cimino. “Approach to Mobile Information and Communication for Health Care.” Vol. 73., 2004.

Michalowski, Slowinski, Wilk, Farion, Pike,Rubin,. Design and Development of a Mobile System for Supporting Emergency Triage. Vol. 44., 2005.

Moyer, C. A., et al. "We Got Mail: Electronic Communication between Physicians and Patients." Am J Manag Care 5.12 (1999): 1513-22.

Palmblad, M. C., and B. C. Tiplady. "Electronic Diaries and Questionnaires: Designing User Interfaces that are Easy for all Patients to use." Quality of Life Research 13.7 (2004): 1199-207.

Pancoast, P. E., T. B. Patrick, and J. A. Mitchell. "Physician PDA use and the HIPAA Privacy Rule." J Am Med Inform Assoc 10.6 (2003): 611-2.

Quinn, P., J. Goka, and H. Richardson. "Assessment of an Electronic Daily Diary in Patients with Overactive Bladder." BJU international 91.7 (2003): 647-52.

Rodriguez, M. D., et al. "Location-Aware Access to Hospital Information and Services." Information Technology in Biomedicine, IEEE Transactions on 8.4 (2004): 448-55.

Rodriguez-Ascariz, Jose-Manuel, et al. "Portable System for Patient Monitoring with Wireless Technologies." Upgrade: The European Journal For the Informatics Professional VI.5 (2005): 46-52.

Shiffman, S., et al. "Comparative Efficacy of 24-Hour and 16-Hour Transdermal Nicotine Patches for Relief of Morning Craving." Addiction 95.8 (2000): 1185-95.

Slack, W. V. "A 67-Year-Old Man Who e-Mails His Physician." JAMA 292.18 (2004): 2255-61.

Stanford, J. B., G. L. White Jr, and H. Hatasaka. "Timing Intercourse to Achieve Pregnancy: Current Evidence." Obstetrics & Gynecology 100 (2002): 1333-41.

Stone, A. A. "Patient Non-Compliance with Paper Diaries." BMJ 324.7347 (2002): 1193-4.

Stone, A. A., et al. "Patient Compliance with Paper and Electronic Diaries." Control Clin Trials 24.2 (2003): 182-99.

Stovall, D. W., et al. "The Effect of Age on Female Fecundity." Obstet Gynecol 77.1 (1991): 33-6.

Tachakra, S., et al. "Mobile e-Health: The Unwired Evolution of Telemedicine." Telemedicine Journal and e-Health 9.3 (2003): 247-57.

Wyrwich, K. W., and V. M. S. Tardino. "A Blueprint for Symptom Scales and Responses: Measurement and Reporting." Gut 53.4 (2004): 8.

Appendix A: Survey for Health Professionals

Exit this survey >>

1. Background

Please tell us about your background.

1. Name

2. E-mail Address

3. Age

19 or younger | 20-29 | 30-39 | 40-49 | 50-59 | 60 or older

4. Occupation

5. Experience in your occupation

Less than 1 year | 1 to 5 years | 6 to 10 years | 11 to 20 years | More than 20 years

6. Specialty (if applicable)

Next >>

2. Experience with Mobile Devices

Please tell us about your experience with mobile devices.

6. Do you use a mobile phone?

- Yes
- No

7. If you use a mobile phone, what do you use it for (check all that apply)?

Voice calls | Photos | Text messaging | E-mail | Web | Calendar/Contacts | Other

8. Do you use a personal digital assistant (PDA)?

- Yes
- No

9. If you use a PDA, what do you use it for (check all that apply)?

Voice calls ☐ Photos ☐ Text messaging ☐ E-mail ☐ Web ☐ Calendar/Contacts ☐ Other ☐

10. Do you use any other mobile devices besides a mobile phone or PDA? If so, describe them.

11. Do you use your mobile phone, PDA, or other mobile device for work-related duties?

Yes ○ No ○

12. If you use your mobile phone, PDA, or other mobile device at work, what do you use it for?

13. Do your coworkers use mobile phones, PDAs, or other mobile devices for work-related duties?

Yes ○ No ○

14. If your coworkers use their mobile phones, PDAs, or other mobile devices at work, what do they them for?

<< Prev **Next >>**

3. Patient Interaction

Please answer some questions about how you get information from your patients.

15. How do you usually get information from patients about their health? For instance, from paper forms? From face-to-face questioning?

16. How long is your typical face-to-face interaction with a patient during a typical appointment?

Less than 5 minutes ☐ 5 to 15 minutes ☐ 16 to 30 minutes ☐ More than 30 minutes ☐

17. During a typical appointment, what type of health information do you get from a patient?

18. Have you ever had your patients keep an ongoing record of their health status (i.e., keep a health journal)?

Yes No

<< Prev **Next >>**

4. Patient Interaction (cont'd)

19. If you had your patients record information about their health status, what information did they record?

20. How did they record information about their health status? For instance, on paper? On a computer?

<< Prev **Next >>**

5. Tracking Health Status With Mobile Devices

Please answer some questions about patients using mobile devices to track their health status.

21. Do you think having patients record information about their health status using a mobile device and having that information available to you could help you do your job?

Yes No Maybe

<< Prev **Next >>**

6. Tracking Health Status With Mobile Devices (cont'd)

22. How do you think having patients record information about their health status using a mobile device would help you?

23. What information would you like them to record?

24. When would you like to monitor the information recorded by patients (check all that apply)?

- ☐ At appointments
- ☐ When they phone
- ☐ Between appointments
- ☐ When called to your attention because a "red flag" appears in the data
- ☐ Other times

25. How would you like to view the information (check all that apply)?

On the mobile device	On a PC	As a printout	Other	Not Sure
☐	☐	☐	☐	☐

26. In what form would you like the information displayed (check all that apply)?

As text and numbers	As a graph or chart	Other	Not Sure
☐	☐	☐	☐

<< Prev **Next >>**

7. Tracking Health Status With Mobile Devices (cont'd)

27. What are issues that you think might keep patients from using mobile devices to track their health status?

28. What are issues that you think might keep you or other healthcare providers from using information collected by patients on their mobile devices?

29. Are you aware of existing products that allow patients to record information about their health status on an ongoing basis?

Yes No

<< Prev **Next >>**

8. Tracking Health Status With Mobile Devices (cont'd)

30. If you know of existing products, please describe them (include name/manufacturer, if you know them).

31. Have you used such a product?

Yes No

<< Prev **Next >>**

9. Tracking Health Status With Mobile Devices (cont'd)

32. If you have used such a product, when did you use it?

33. What did you like about it?

34. What didn't you like about it?

35. What features do you wish it had?

36. What did your patients think of it?

<< Prev Next >>

10. Tracking Health Status With Mobile Devices (cont'd)

37. Do you think cost would be an important factor in whether such a mobile system would be adopted by healthcare providers and patients?

38. If you could have a "dream" health monitoring system to send home with your patients, what would that system do?

<< Prev Done >>

Appendix B: Healthcare Professional Survey Results

Respondent	#1	#2	#3	#4	#5
Age	30-39	40-49	50-59	60 or older	60 or older
Occupation	physician	Clinical Research Nurse, RN	Hospital administrator	RN	Physician
Experience in your occupation	6 to 10 years	6 to 10 years		More than 20 years	More than 20 years
Specialty (if applicable)	Emergency Medicine	HPV vaccine research	Long-term care	Family practice	Emergency Medicine
Do you use a mobile phone?	Yes	No	Yes	Yes	Yes
If you use a mobile phone, what do you use it for (check all that apply)?	Voice calls		Voice calls	Voice calls	Voice calls
	Text messaging			Text messaging	Photos
Do you use a personal digital assistant (PDA)?	No	No	No	No	Yes
If you use a PDA, what do you use it for (check all that apply)?					Other
Do you use any other mobile devices besides a mobile phone or PDA? If so, describe them.		Pager on rare occasions		No	MP3 player
Do you use your mobile phone, PDA, or other mobile device for work-related duties?	No	Yes	Yes	No	Yes
If you use your mobile phone, PDA, or other mobile device at work, what do you use it for?		As a pager			Phone numbers, medical data and conversation
Do your coworkers use mobile phones, PDAs, or other mobile devices for work-related duties?	Yes	Yes	Yes	No	Yes
If your coworkers use their mobile phones, PDAs, or other mobile devices at work, what do they them for?	Drug information, calendar management, Internet access.	Urgent and routine communications. Important patient care questions.			Phone numbers, medical data and conversation
How do you usually get information from patients about their health? For instance, from paper forms? From face-to-face questioning?	Hospital-based computer records system, face to face, paper records.	Its pretty hands on. Face-to-face questioning, direct telephone triage assessment, physical exams. Get results from the computer, notes from patient charts.	Both	Face-to-face interviews and paper forms	Face to face and computer records
How long is your typical face-to-face interaction with a patient during a typical appointment?	16 to 30 minutes	More than 30 minutes	More than 30 minutes	5 to 15 minutes	Less than 5 minutes
During a typical appointment, what type of health information do you get from a patient?	History of present illness, past medical history, past surgical history medications,	Name, gender, birth date, social security number, address, insurance info. Medical history,	Initial appointment 60 minutes, subsequent 15 minutes. Get current	How they are feeling, temp, BP, Pulse, Respirations, operations, medications,	History, past and present, etc.

	allergies, social history, family history	including medication, psych and sexual history; physical exam, including vital signs; any side effects; symptoms of any illnesses, etc.	status in a typical appointment	etc.	
Have you ever had your patients keep an ongoing record of their health status (i.e., keep a health journal)?	Yes	Yes	No	No	Yes
If you had your patient's record information about their health status, what information did they record?	Either a daily log of symptoms or recordings of weight, blood sugar, etc. some patients use PC program to organize their personal medical history, medications, etc...	Temperature reading, symptoms after injection--local reactions or systemic reactions, any medications they took. The date of occurrences and quantified amounts.			Medications vital signs and symptoms
How did they record information about their health status? For instance, on paper? On a computer?	paper, napkins, computer, wallet cards (kaiser)	Recorded in a special booklet.			paper
Do you think having patient's record information about their health status using a mobile device and having that information available to you could help you do your job?	Maybe	Yes	Maybe	Yes	Maybe
How do you think having patients record information about their health status using a mobile device would help you?	portable info	Ensure compliance and gets results faster and be able to respond to any unusual situations quicker.	I would question the accuracy of patients assessment	Double checking their medications, dosage, times they are taking them, side effects, efficacy, etc. Double check if they are taking any OTC medications that could interact with their prescribed medicines.	not sure
What information would you like them to record?	PmHx, PsHx, Medications, Allergies, Code status	study data such as temperature, site reaction or systemic symptoms--along with a rating of severity and any	symptoms that would trigger intervention i.e., headache, dizziness, shortness of breath, lack of	All the above	symptoms and time with medications and vital signs and past medical history

		medications used.	appetite, any change in body elimination, prolonged sadness, pain that is not resolved by medications		
When would you like to monitor the information recorded by patients (check all that apply)?	At appointments	Between appointments	At appointments	At appointments	At appointments
	When called to your attention because a 'red flag' appears in the data		When they phone	When they phone	
			Between appointments	Between appointments	
				When called to your attention because a 'red flag' appears in the data	
How would you like to view the information (check all that apply)?				On the mobile device	
	On a PC	On a PC		On a PC	
	As a printout	As a printout	As a printout		As a printout
In what form would you like the information displayed (check all that apply)?	Not Sure	As text and numbers	As a graph or chart	As text and numbers	As text and numbers
				As a graph or chart	
What are issues that you think might keep patients from using mobile devices to track their health status?	big fingers, bad eyes, problems with accessing the info; interface with other systems.	They might forget. they might not want to use their minutes in this way. they may not know how to do it.	memory impaired	lack of technology and familiarity with the mobile device	ease of use
What are issues that you think might keep you or other healthcare providers from using information collected by patients on their mobile devices?	interface issues	If it appears erroneous, like they accidentally pushed the wrong button-- There exists a major confidentiality issue with HIPPA and everything...	need to establish use pattern	Making sure the devices are user friendly	non meaningful data
Are you aware of existing products that allow patients to record information about their health status on an ongoing basis?	No	Yes	Yes	No	No
If you know of existing products, please describe them (include name/manufacturer, if		I don't know, but I know that diabetic patients have monitors	computerized vitals monitoring HomMed		

you know them).		that track data such as blood glucose and save it.			
Have you used such a product?		Yes	Yes		
If you have used such a product, when did you use it?		this probably isn't the type of machine that you would want to compare to--very basic	will purchase in 30 days	I know the following weren't what you had in mind but, they came to my mind right away. For Diabetics, there are the Blood Glucose Monitoring Systems that measure and average their daily blood sugars. There are blood pressure monitoring devices that measure BP and print out records also	
What did you like about it?		this probably isn't the type of machine that you would want to compare to--very basic	accuracy of information not relying on the patient interpretation of the data	N/A	
What didn't you like about it?		this probably isn't the type of machine that you would want to compare to--very basic I thought it was fine.		N/A	
What features do you wish it had?		no complaints--this probably isn't the type of machine that you would want to compare to--very basic		N/A	
What did your patients think of it?		they liked it--this probably isn't the type of machine that you would want to compare to--very basic		N/A	
Do you think cost would be an important factor in whether such a mobile system would be adopted by healthcare providers and patients?	not really	definitely	yes	Yes for patients more than the health care professionals	yes

If you could have a 'dream' health monitoring system to send home with your patients, what would that system do?	easily accessible info for the office or hospital, ability to patient to input daily recordings, and ability for physician/nurse to read.	It would transmit data and recordings to the doctor's or nurses PC or laptop or mobile device. It would take and record vital signs such as temperature, blood pressure, pulse, Respiratory rate, take a brief video of the patient talking or walking so that you could assess their faces, mood, ambulation, weakness, changes, etc.; check and save blood sugar for diabetics, have all of their medications listed and pictured on the monitor with instructions when they pushed the med button--it would ring to remind them to take their meds or do whatever they need to do. It would allow them to transmit an update or complaint.	insure that I have enough information so that I could act to eliminate re hospitalization	Monitor vital signs, pain threshold, automatically send alerts to the health care providers when needed. Be able to send messages back and forth	

Appendix C: Diary Keeper Interview Questions

Interviewer: We will be asking you some questions about the diaries or journals you've kept about health or lifestyle topics. We primarily interested in the diary-keeping process, not the information you recorded. We're trying to understand how mobile phones might help people more easily record such information.

Questions about your diary

- What prompted you to start using a health diary?
- What diary format did you use (paper, electronic)?
- How long did you keep a health diary?
- What types of information did you record in your health diary?
- How long was a typical entry?
- Was it the same type of information everyday, or did it vary?
- How often did you make entries in your health diary? Did the frequency vary?
- Where were you when you made entries? Did this vary?
- Did you share the information with anyone else (family, friend, doctor)?
- Why did you stop using the diary?

Interviewer: The electronic diary we're considering developing would run on a smart phone. It wouldn't involve users typing in lots of information. Instead, it might ask users multiple-choice questions or let them enter simple numeric ratings about how they are feeling. The system might have wireless features that work via text messaging, e-mail, or the Web.

Questions about mobile phone diaries

- What do you think about using a mobile phone to keep a diary?
- What are some of the advantages you can think of to using a mobile-phone diary?
- What are some of the disadvantages you can think of to using a mobile-phone diary?
- What do you think of the following possible features?
    - transferring information between the phone and your PC
    - sharing your diary information with others wirelessly
    - printing your diary information out on paper
    - having electronic alerts that remind you to make diary entries
    - adding cameraphone pictures to your diary entries
    - adding voice recordings to your diary entries
    - creating charts or graphs based on the information you enter

Appendix D: Diary Keeper Interviews

Interview #1: Weight-Management Diary Keeper

Interviewee #1 is a 22-year-old female student who has kept an online weight-management diary (through WeightWatchers.com) for the past nine months. She keeps track of what she eats and how much she exercises. She does this several times a day using her laptop. She's also kept personal diaries throughout her life.

Key Points

Having the diary close at hand is useful. Talking about why she sometimes doesn't make entries, she says: "I may not have access to the physical journal. I might have put it somewhere and don't have easy access." "Once in a while, if I'm not at my computer, I'll write it on my hand, write down what I just ate. But it's hard sometimes to keep it up."

She likes to be automatically reminded by her journal: "I found a Java app online. Every Tuesday morning a window pops up and asks me about my weight. I always enter it in because it's not going to go away until I respond to it. That's a push situation. I'm honest about it. It's a reminder." "Last semester I wasn't as busy, so it was easier [to keep the journal]. Right now, it's an added stress, so I don't worry about it. But if I was getting reminders asking me what I was eating, maybe I'd be more apt to enter my info."

In keeping the weight-control diary, she thinks interaction with people is important: "With the online diary, I can go to message boards. But if you're not going to those message boards, it's harder. The involvement with other people just helps." "Stats show if you're not going to face-to-face meetings, you're not going to be as consistent."

Interview Notes

Interviewee #1
Date: 2/16/2006
Time: 2:00 p.m.
Interview Location: South Hall basement lounge
Gender: Female
Age: 22
Occupation: Full-time student (grad student)

What prompted you to start using a diary?

My whole life I've tried to have a diary. I usually start with gusto, then my consistency wanes. Maybe it's the perceived effort. It doesn't seem worth the time investment after a while. Or it's not there--I may not have access to a physical journal. I might have put it somewhere and don't have easy access.

What type of information did you track?

Weight Watchers information. WeightWatchers.com system to help you monitor "points" online. Calories, fat, fiber, etc. Vitamins taken. The main thing is to track what I've eaten during the day. It lets me easily search for foods. My most recent thing is to manage what I've eaten everyday and my activity level. There's a Palm app you can download. I imagine the Palm app is similar to the online app. The site includes foods, exercises, access to recipes. I did the same form when I was younger, but in a paper journal.

My roommate and I keep a record of wines. We keep the labels and review them.

I have to go to the Web site. [Shows us the Weight Watchers site.] I have to do it. This is a huge part of how lots of people try to lose weight or manage their health. There is a level of accountability. With the online diary, I can go to message boards. But if you're not going to those message boards, it's harder. The involvement with other people just helps.

Fitness aspect: search for the activity, then type in how long you've done it. This info is combined with the dietary input.

How long did you keep your diary?

Not consistent. Been paying for Weight Watchers ($17/month) since last May. But I don't go to it as often as I like. Any time I've tried journaling…

I found a Java app online, every Tuesday morning a window pops up and asks me about my weight. I always enter it in because it's not going to go away until I respond to it. That's a push situation. I'm honest about it. It's a reminder.

I'd go online every time I eat, to see how it fits into my day. If I'm half-assing it, I might go on once or twice a day.

There's no personal interaction on the Web site. I could go to actual meetings, at a center. But I don't do that.

Please describe the format of the journal. Describe any set forms to fill out or typical pieces of information that were routinely recorded? (Prompt user for more information about rating scales, etc. as needed.)

[Online Weight Watchers journal.]

How often did you record this information?

[Several times a day, usually after meals. Not always consistent, though.]

Was it the same type of information everyday, or did it vary?

[Varies with meals.]

Were you recording the information with the expectation of sharing it with another person or only for personal use? If shared, what is your relationship with the person you are sharing it with (patient, spouse, etc)?

Mostly do it for myself. This is totally for me. I was an overweight child. A lot of people when they gain weight, they think, I why did I not stick with it?

I don't want to get to a point, look at myself, and think that.

Where were you when you made entries (for instance, at home or work)? Did this vary?

Anywhere. I use my laptop. Once in a while, if I'm not at my computer, I'll write it on my hand, write down what I just ate. But it's hard sometimes to keep it up. Stats show if you're not going to face-to-face meetings, you're not going to be as consistent. That's why I think the reminders are very important. I have my computer around as much as I used to have pads of paper around.

Why did you stop using the diary?

Just don't feel like it. I think, "I'll do it in the future" I don't have time. I don't want to admit that I'm not sticking with the program. You caught me right now at a point when it's not a priority and I don't care. Last semester I wasn't as busy, so it was easier. Right now, it's an added stress, so I don't worry about it. But if I was getting reminders asking me what I was eating, maybe I'd be more apt to enter my info.

A lot of people have psychological factors that they are dealing with too. Overweight people might have heart disease, they might smoke, maybe they are alcoholics. They have lots of problems to address at the same time. They are interrelated. If you quit smoking, you're going to gain weight.

Let's say I was consistent with my journal. The program could start correlating lifestyle choice (what I eat, when I sleep, etc.) with whether I'm losing or gaining. You could also look at statistics from many people.

I would like to have it advise me, rather than have it give me a chart. Just advise me.

Did you ever have difficulty recording the information as directed (or as you wished)? If so, what factors contributed to this difficulty?

[See "Why did you stop using the diary?" above.]

How would you react to the idea of recording information electronically with a mobile device such as a mobile phone or PDA?

I've seen apps on Verizon. I'm a good typer on the phone, but having to type in something and waiting for it to respond, that might be hard. I wouldn't mind being able to text message about what I ate, and then come back to it on my computer. Maybe access it later on the phone.

I would love to be able to send stuff, text message stuff when I don't have a computer, so I can follow up later. Something to remind me.

Given your previous experience keeping a diary, what do you think of the following possible features of an electronic diary?

- **Being able to transfer information between the mobile device and your PC**

  [Covered above.]

- **Being able to share your diary information with others wirelessly**

  I guess if I had to talk to a doctor, that would be appropriate. But for this situation, no. I have tendonitis right now on my knee. It might be nice to keep a diary about how it feels so I can communicate it with a doctor. Sometimes I share pictures with my dad. Like text messaging, you're experiencing something, and you want to share it with your friend.

- **Being able to print diary information out on paper**

  [Not important.]

- **Being able to receive electronic alerts to remind you to make entries**

  [She would like this a lot, as noted above.]

- **Being able to include cameraphone pictures with your diary entries**

I take picture of weird stuff on campus. I was doing some research, and there was a study where you could take a picture of bar code and get health information. Sweden or Denmark or somewhere.

- **Being able to add voice recordings to your diary entries**

I don't do voice recording. My dad does, but I don't .

- **Being able to create charts or graphs based on the information you enter**

I enter my weight once a week. The system will make a comment whether I went up or down. I would like it to be a little less predictable. I've seen things over and over again. "Try tracking your weight every week" But it doesn't say, "We saw you did well on Thursday and Friday, Maybe you should try this…" It says the same things over and over. There are like 6 or 7 canned messages. There's a random quote generator to give you a quote if you've done really well.

I think the graphs are helpful, but I'm not consistent, so the graphs don't really help me. But say someone is recording something everyday, like fertility, they would want to look at their four-week cycle.

Other comments:

I probably have a collection of 5 journals that I've started but never finished. I'm not good at writing paragraphs of text. Those are what I fail miserably at. [So simple multiple-choice questions might be good.]

It would be cool to aggregate all my outgoing text messages to see what I've been talking about. See what people are saying back to me.

There are times where I've tracked exercising. I did some lifting, track sets, reps, weights. I definitely have followed plans, like in Fitness Magazine. I'd bring the magazine with me and annotate the articles as I did the workouts.

I'm surprised that there aren't software programs that run on your iPod for this.

Interview #2: Sleep Diary Keeper

Interviewee #2 is a 35-year-old male who kept a sleep diary over five months by request of his medical specialists. He kept track of sleep-related information on paper-based templates supplied by his specialists. The information included the time he went to bed, the time he awoke, quality of sleep assessments, and dietary and lifestyle issues that might be relevant to his sleep. The information was combined with polysomnograph tests to provide a diagnosis for his sleep problems.

Key Points

Found it hard to fill the information out daily as directed by his doctors because he was busy: "I would record information for all days, but I'd only enter it maybe twice a week. I was suppose to do it every day. That's what you're advised to do. It wasn't on a schedule. I would do it between classes. I was going to business school at the time."

Because he didn't fill it out everyday, sometimes filling it out accurately was a challenge: "Time was a factor. If I let it lapse for a few days, recollection was a problem. Had it been more available on a computer, it would've been more conducive to filling it out." "[For filling in time info,] I was usually close about times, but probably not always right."

Was more motivated to fill the information out after he knew how the data was to be used: "Initially it [keeping the diary] was an annoyance, largely because it wasn't well explained how it would be used and what the end goal was. I can't say I ever wanted to do it, but I was more amenable to the process after the first test since after that I knew about how the log was used in making determinations."

Thought a mobile diary might be good for convenience: "Given the circumstances of school and not being in the same place all the time, if I didn't have a laptop at the time at school or on the bus, I could record things on a mobile device."

But the open-ended nature of some of the questions would make it hard to use a mobile device: "So I suppose most of it could've been done on a phone or PDA, but not all of it. The open ended questions: What caused the nighttime arousals. 'Other' categories."

Interview Notes

Interviewee #2
Date: 2/18/2006
Time: 1:00 p.m.
Interview Location: Pleasant Hill, CA
Gender: Male
Age: 35
Occupation: Manager, Publishing

What prompted you to start using a diary?

I started it after seeing my physician and being referred for a polysomnogram, I was advised to keep a sleep log to assess "sleep hygiene." This means the environmental effects that you can control. Is there noise that wakes you? Is there light?

What type of information did you track?

I tracked my bedtime. What time I woke up. Number of nighttime arousals. Quality of sleep. Any sort of dietary info, alcohol, drugs--anything that would impact sleep. The following day, how I felt. Lethargic? Whether I took a nap during the day. Ability to concentrate.

I was given a template. A piece of paper. Primarily asked for qualitative information. But there was a rating for "quality of sleep over past night." 1 (worst quality) to 10 (best quality). For the qualitative stuff, I jotted down a few words here and there.

How long did you keep your diary?

Kept it five months.

Please describe the format of the journal. Describe any set forms to fill out or typical pieces of information that were routinely recorded? (Prompt user for more information about rating scales, etc. as needed.)

It was a paper-based template. A stack of printed pieces of papers. I probably would have been more vigilant if I it had been in an Excel spreadsheet.

How often did you record this information?

Probably twice a week. I would record information for all days, but I'd only enter it maybe twice a week. I was suppose to do it every day. That's what you're advised to do. It wasn't on a schedule. I would do it between classes. I was going to business school at the time.

Was it the same type of information everyday, or did it vary?

Same information every day.

Were you recording the information with the expectation of sharing it with another person or only for personal use? If shared, what is your relationship with the person you are sharing it with (patient, spouse, etc)?

I would share it with my sleep doctors. Usually they were pulmonologists. Also neurologists. At the time of a polysomnogram, the sleep diary data together with the lab results would go to the doctor. I was told that the data was entered into a computer and based on the lab results a diagnosis was made.

Where were you when you made entries (for instance, at home or work)? Did this vary?

[Usually at home.]

Why did you stop using the diary?

I wasn't doing anymore polysomnograms and had received my diagnosis.

Did you ever have difficulty recording the information as directed (or as you wished)? If so, what factors contributed to this difficulty?

Time was a factor. If I let it lapse for a few days, recollection was a problem. Had it been more available on a computer, it would've been more conducive to filling it out.

How would you react to the idea of recording information electronically with a mobile device such as a mobile phone or PDA?

I think most of it must've been converted to quantitative results [by the doctors]. So I suppose most of it could've been done on a phone or PDA, but not all of it. The open ended questions: What caused the nighttime arousals. "Other" categories.

Given your previous experience keeping a diary, what do you think of the following possible features of an electronic diary?

- **Being able to transfer information between the mobile device and your PC**

  Given the circumstances of school and not being in the same place all the time, if I didn't have a laptop at the time at school or on the bus, I suppose could record things on a mobile device.

- **Being able to share your diary information with others wirelessly**

  That would've made it easier for the doctors.

- **Being able to print diary information out on paper**

  Yes. But if it was done wirelessly, I wouldn't need to print it out. But that would be another option [for getting it to the doctors].

- **Being able to receive electronic alerts to remind you to make entries**

  Yes.

- **Being able to include cameraphone pictures with your diary entries**

Not relevant in this case.

- **Being able to add voice recordings to your diary entries**

Yes, for the open-ended questions.

- **Being able to create charts or graphs based on the information you enter**

For me no. Well, I was interested. But I don't know if it was my place to know this info. But it might be interesting to see a graph of my sleep efficacy.

Other info:

[For filling in time info,] I was usually close about times, but probably not always right.

Initially it [keeping the diary] was an annoyance, largely because it wasn't well explained how it would be used and what the end goal was. I can't say I ever wanted to do it, but I was more amenable to the process after the first test since after that I knew about how the log was used in making determinations and diagnoses. Once I understood the process better, it was easier to keep the log.

Interview #3: Fertility Diary Keeper

Interviewee #3 is a 45-year-old female who kept a fertility diary several years ago while trying to conceive. She kept the diary for two months and communicated the information to her gynecologist and fertility specialist. She used a paper-based calendar to keep track of the information, which included the start of her period and the days she was ovulating. She used a urine test to check ovulation.

Key Points

She likes to keep track of things on paper, and couldn't see herself using an electronic diary: "I don't use my phone now for anything but making calls. For a lot of things, I prefer to use paper. My calendar, my to-do lists. I'm more comfortable with paper. I don't have a PDA."

If was to use an electronic diary, she thought the reminder alerts, graphing of data, and printing capability would be useful for fertility tracking.

She didn't encounter any particular difficulty keeping track of the information: "It was pretty minimal."

Interview Notes

Interviewee #3
Date: 2/19/2006
Time: 8:00 p.m.
Interview Location: Twin Bridges, CA
Gender: Female
Age: 45
Occupation: Homemaker

What prompted you to start using a diary?

The desire to get pregnant. I don't quite remember the sequence of events. I think my husband and I tried for a couple of months, without success. I had already been pregnant once before. I think I started keeping track on my own so I could tell my doctor what was happening. This was the fall of 2002. I was 42.

I think I also kept track of my cycle when I began seeing a fertility specialist, which was a few months later.

What type of information did you track?

I just wrote down the first day of my period and for the months I used an ovulation predictor, I wrote down an "O" on the days I was ovulating. [How long did the ovulating days last?] It seemed like the package came with a few sticks that you peed on. It seemed like you had to time it pretty close. You wanted to use the sticks around the time you would be ovulating. The symbol on the stick would appear stronger when you were ovulating. Maybe there were three or four ovulating days? I don't remember.

How long did you keep your diary?

Two months. I did that and then I went to the doctor. [Did you continue to do it after you saw the doctor?] I don't think so. The doctor put me on something. I don't know if it was Clomid or something else.

Please describe the format of the journal. Describe any set forms to fill out or typical pieces of information that were routinely recorded? (Prompt user for more information about rating scales, etc. as needed.)

I used a regular weekly calendar.

How often did you record this information?

Only when I'd need to put down a "P" [beginning of period] or an "O."

Was it the same type of information everyday, or did it vary?

[Already covered this.]

Were you recording the information with the expectation of sharing it with another person or only for personal use? If shared, what is your relationship with the person you are sharing it with (patient, spouse, etc)?

I told my doctor about the what I was keeping track of. My gynecologist and my fertility specialist.

Where were you when you made entries (for instance, at home or work)? Did this vary?

At home. The calendar was in the kitchen. It was our regular calendar.

Why did you stop using the diary?

[N/A]

Did you ever have difficulty recording the information as directed (or as you wished)? If so, what factors contributed to this difficulty?

No. It was pretty minimal.

How would you react to the idea of recording information electronically with a mobile device such as a mobile phone or PDA?

I don't use my phone now for anything but making calls. For a lot of things, I prefer to use paper. My calendar, my to-do lists. I'm more comfortable with paper. I don't have a PDA.

Given your previous experience keeping a diary, what do you think of the following possible features of an electronic diary?

- **Being able to transfer information between the mobile device and your PC**

  I think the only reason I would ever want to do that was if I wanted to print it out or use some sort of analysis tools that were available on the computer. Otherwise, probably not.

- **Being able to share your diary information with others wirelessly**

  If the doctor wanted it wirelessly, that would be a good feature. I would need to know that he or she would want the information that way.

- **Being able to print diary information out on paper**

  I would probably use that.

- **Being able to receive electronic alerts to remind you to make entries**

  I would probably use that because I get busy and forget to write things down.

- **Being able to include cameraphone pictures with your diary entries**

  I can't think of using that with fertility. Maybe other things. If you were tracking some health issue where there was something visible. I have a family member who has to keep track of his moles, what they look like, for his doctor. I could see pictures being useful for that.

- **Being able to add voice recordings to your diary entries**

  I can't see doing that.

- **Being able to create charts or graphs based on the information you enter**

  That would be useful, yes.

Interview #4: Fertility Diary Keeper

Interviewee #4 is a 36-year-old female who kept a fertility diary two times in her life—in the months before each of her two children was conceived. Both times, she kept track of her menstrual periods for several months to gauge the length of her cycle, then used a urine test to pinpoint ovulation. She used a paper-base calendar to track the information

Key Points

Thinks that fertility tracking would be valuable if it was integrated with pregnancy tracking:
"After ovulation, it could alert you to take a test to see if you're pregnant--and it could recommend a kit. And if you're pregnant, it could figure out your due date based on all the information you've entered. I think there's a lot you could do with this idea."

Preferred keeping track of the information on paper: "[Re: using a mobile device to track fertility,] I don't know if I would do it. I could see my husband using it. I can see the benefits of it. I'm always the last one to absorb new technology in my life."

Could see the benefits of an electronic diary: "A paper-based diary is not the greatest thing. You're flipping back and forth between previous dates to figure when to do things. This can increase human error. And if you lose your diary, you're screwed."

Since she got pregnant immediately, didn't have to share the information with her doctor: "I didn't share this with my doctor, but if it hadn't worked, I probably would have."

Thinks most women would do the hormone test rather than the other tests (temperature, cervical data, etc.): "I don't know why people would do the temperature test, or any of the other tests. If you have the resources to have a cell phone, you have the resources to buy a kit and pee on a stick." "[Regarding cervical mucus and cervical position] Too many American women aren't comfortable sticking things in their vagina. That's why the cervical cap was taken off the market. No one was using it in the U.S. Lots of women still use it in other countries."

Interview Notes

Interviewee #4
Date: 2/20/2006
Time: 9:00 p.m.
Interview Location: Phone Interview
Gender: Female
Age: 36
Occupation: Non-Profit Director/Attorney

What prompted you to start using a diary?

We wanted to have a baby, and I had stressed over prior medical problems. I was concerned I wouldn't be able to conceive. I wanted to make sure if there was a problem, I'd know about it as soon as possible.

What type of information did you track?

Menstrual cycle length, the numbers of days from your last period, and the number of days you were taking the test for. I bought a kit.

I think it would be cool if software could accompany the kit. You have to figure out average length of your cycle. You have to have a rough idea of number of days. Depending on the number of days, you start peeing on this stick at a different time. You only have a certain number of strips, so the kit says, "If your average is 28 days, you start peeing on the stick on this day…"

When you are shown to be fertile, you have to have sex within 24 hours. You have a 24-hour window.

My cycle is really regular. So that made it easier. It would be harder if your cycle fluctuated a lot. This can happen when a woman goes on and off the pill. For those women, you have to find an average.

There are other ways of checking (temperature). But I wanted to be definite, use something that had a lower error rate. So I went for the chemical test.

It turned out I didn't know when I was ovulating. It turned out I was totally wrong. So it was good that I used the test.

How long did you keep your diary?

I tracked my menstrual cycle for 3 months to be sure about cycle. Then I got the kit. I got one stick away from the last one and it finally showed a spike in hormone. My husband and I had sex and I got pregnant.

This happened fours years later with baby number two. The same thing happened.

Please describe the format of the journal. Describe any set forms to fill out or typical pieces of information that were routinely recorded? (Prompt user for more information about rating scales, etc. as needed.)

I put dates in my daily calendar. The one I carry around. One of those paper-based organizers.

How often did you record this information?

I guess not that much. I just had keep track of first and last days of my period for 3 months.

Was it the same type of information everyday, or did it vary?

Each one of the things I was doing, it was the same information.

If it hadn't worked so smoothly, I would've had to figure out where I made a mistake. They have troubleshooting things, how to alter the schedule.

Were you recording the information with the expectation of sharing it with another person or only for personal use? If shared, what is your relationship with the person you are sharing it with (patient, spouse, etc)?

Most of the time it was for personal use. But closer to the ovulation, I was sharing it with my husband.

The second thing you track is if you got pregnant. You figure out how many days have past since ovulation so you know when you can take pregnancy test. They don't work until a few days after your expected period start date.

I didn't share this with my doctor, but if it hadn't worked, I probably would have.

Where were you when you made entries (for instance, at home or work)? Did this vary?

I was probably at home. But I could've done it anywhere.

If there were a little program that came with the test kit, it could be really cool. You could track all the information. That would be nice. An alert could go off and tell you need to start peeing on the sticks. Then, after ovulation, it could alert you to take a test to see if you're pregnant--and it could recommend a kit. And if you're pregnant, it could figure out your due date based on all the information you've entered. I think there's a lot you could do with this idea.

Why did you stop using the diary?

I was successful at getting pregnant.

Did you ever have difficulty recording the information as directed (or as you wished)? If so, what factors contributed to this difficulty?

A paper-based diary is not the greatest thing. You're flipping back and forth between previous dates to figure when to do things. This can increase human error. And if you lose your diary, you're screwed.

How would you react to the idea of recording information electronically with a mobile device such as a mobile phone or PDA?

I don't know if I would do it. I could see my husband using it. I can see the benefits of it. I'm always the last one to absorb new technology in my life. If you can build in the capacity to tell you when to take the test or get a pregnancy test, that would be really cool. And then calculate the due date. That could be really exciting.

Given your previous experience keeping a diary, what do you think of the following possible features of an electronic diary?

- **Being able to transfer information between the mobile device and your PC**

  Yes, I think that would be good. As a backup. Or if your battery runs down regularly, like mine does, that would be a good idea.

- **Being able to share your diary information with others wirelessly**

  I suppose that would be a cool idea. But I'd have privacy concerns. But I don't know. It would be a cool thing. If there were problems, and you wanted to get the info to your provider, that would be easy and user friendly.

- **Being able to print diary information out on paper**

  I would like that. My husband, on the other hand, would prefer it being shared wirelessly. Sometimes if you want to talk to someone about it, it can be nice to have a paper print out so you can talk to the other person about it. Ovulation and fertility is a personal subject, so being able to talk about it face-to-face with a printout can be important. Sometime technology can be a barrier

- **Being able to receive electronic alerts to remind you to make entries**

  Yeah, that would be good. I would like that.

- **Being able to include cameraphone pictures with your diary entries**

  I don't see the benefit for this. But if it was a more general pregnancy journal, this could be useful Like the stuff they have on BabyCenter. "Right now your baby is the size of an avocado." The BabyCenter stuff is fun, especially for first pregnancies.

- **Being able to add voice recordings to your diary entries**

  That could be cute, if people were excited about getting pregnant. Or you could personalize your alerts with your own message.

- **Being able to create charts or graphs based on the information you enter**

  Probably. It depends. If you were doing the temperature ovulation, that would make sense. But not the way I was doing things.

Other info:

I don't know why people would do the temperature test, or any of the other tests. If you have the resources to have a cell phone, you have the resources to buy a kit and pee on a stick.

I'm pretty compulsive about doing stuff when if it comes down to it. But I decided why should I be taking my temperature? Too much work.

It seems like that would be good to couple this with a kit. It would suck people into other products

[Regarding cervical mucus and cervical position] Too many American women aren't comfortable sticking things in their vagina. That's why the cervical cap was taken off the market. No one was using it in the U.S. Lots of women still use it in other countries.

Interview #5: Sports Training Diary Keeper

Interviewee #5 is a 34-year old female who kept a sports training diary for several months a few years ago. She used an online service to train for the triathlon (www.trainingpeaks.com). She kept track of exercises, and items such as heart rate, distance, repetitions, and also questions about how she felt that day on a 1-10 scale. She entered the information into the online diary usually the next day while she was at work. The online diary also encouraged interaction with her online coach.

Key Points

She often didn't record the exact information when using training machines and even then didn't record it for 2 or 3 days and would like to just record the information from the machines automatically. Paraphrase: Often you just don't really have anything with you to write things down. I just tried to remember and then enter it later, but it wasn't as critical to know exactly in this use. It would be nice if the machine recorded it and transferred it automatically. I don't know if I'd take the time to enter everything exactly since it's not critical to be exact for what I'm doing.

Information must be accessible online or from desktop computer. Paraphrase: I needed to enter information and I shared it with my coach online. All the communication was online through the web site. It's absolutely essential for this type of application to have the data online somehow. Maybe I upload it by Bluetooth, but it has to be transferred someplace else besides the phone. Said she needed to view it on her PC.

Entry interfaces might need to be flexible and not too constrained. **People's habits might not match rigidly constrained expectations.** Paraphrase: Sometimes I would answer questions about my workout and the assumptions were incorrect. It had very fixed goals or questions. So it would ask me about things I hadn't done that day like "How did you feel after you ran five miles" but I hadn't run five miles that day or had stopped short of that. (This may also relate to allowing people to move past a question and not requiring all information every time if it won't be available.)

Social incentives/aspects are anywhere from important to "fun" such as sharing with coach, messaging friends or taking a photo during workout. She said she needed to share the information with a coach, she thought it would be fun to message or chat with friends about workout that were also working out and it would be fun to see photos of things along the way (jogging, etc). Maybe share workout information with friends was moderately important.

Neither printout or reminders seemed important to her. She said that alerts would annoy her and she had no need to do print things since the entire experience was web-centric.

Charts and graphs of progress over time would motivate and be useful. Not only would it be fun to see this information, but it would be really fun to do so and try and spot trends.

Interview Notes

Interviewee #5
Date: 02/21/2006
Interview Location: South Hall
Gender: Female
Age: 34
Occupation: Student

Basic information:

Sports Diary trainingpeaks.com, other (pedometer and automatic upload, active.com)

What prompted you to start using a diary?

Engaged in training program for triathlons. The training diary was part of the coaching package. Trainingpeaks.com is what she used.

Communicated workouts and recorded how much fulfilled.

What type of information did you track?

Duration, distances, etc. For triathlon. Pace, heart rates, distances, workouts completed. Lots of questions from 1-10 how you felt. Quality of diet. Also freeform questions by text. Also weight.

How long did you keep your diary?

2 months.

Please describe the format of the journal. Describe any set forms to fill out or typical pieces of information that were routinely recorded? (Prompt user for more information about rating scales, etc. as needed.)

It was on a web site. Enter core data to get started: age, weight, base fitness information. Continually entering updates into forms. Calendar and it had links off a calendar to enter data. Drill down from calendar. A link on the interface for updating the data for the day.
Text boxes mostly.

How often did you record this information?

Supposed to be daily, but she did it most days, but at times skipped days. Often 2 or 3 day delay before she would go back and enter data.

You go back and enter it later but you don't have something with you. Often the next day at work. Flow: look at bike computer, remember, enter on site and enter next day.

Was it the same type of information everyday, or did it vary?

It varied depending on sport, biking, swimming, running, weight lifting.

Were you recording the information with the expectation of sharing it with another person or only for personal use? If shared, what is your relationship with the person you are sharing it with (patient, spouse, etc)?

Sharing it with a coach. The coach would access it online and he'd make comments and it was the primary mode of communication.

Where were you when you made entries (for instance, at home or work)? Did this vary?

Mostly at work, sometimes at home. Desktop computer.

Why did you stop using the diary?

She stopped training because school started and she didn't want to pay for service she wasn't using. Wanted to keep the data after she had stopped using it. She could have downloaded into excel.

Did you ever have difficulty recording the information as directed (or as you wished)? If so, what factors contributed to this difficulty?

Nothing too problematic. Bike transferring to PC. Had a hard time entering information was very constrained and there was an implied assumption that she had completed everything and what the data was to that.

How would you react to the idea of recording information electronically with a mobile device such as a mobile phone or PDA?

Most useful if you could do an automatic port of data from the device such as bike to phone. Or automatic port of data from mobile into computer or web site. The mode seems to be to use web sites to track things. Qualtiy and time for capture.

Often capture the basics such as distance and time would be helpful.

Given your previous experience keeping a diary, what do you think of the following possible features of an electronic diary?

- **Being able to transfer information between the mobile device and your PC**

  Yes. Important to do so.

- **Being able to share your diary information with others wirelessly**

  Moderately important. Chat with friends to say how much they had done with each other.

- **Being able to print diary information out on paper**

  Not really important. Because web is the central paradigm. Calendar would be electronic. Wouldn't post it. Everything is on PC.

- **Being able to receive electronic alerts to remind you to make entries**

  Alert would just irritate me. There is not the sense of urgency with health stuff.

- **Being able to include cameraphone pictures with your diary entries**

  Useful on runs and bike rides. It would be fun.

- **Being able to add voice recordings to your diary entries**

  Probably wouldn't use it.

- **Being able to create charts or graphs based on the information you enter**

Very useful and see the progress over time.

It would be interesting to keep log of last few entries. Maybe chart for past week or something so you can get a quick look at how things are going. Feedback on last week or last 10 entries. This is a fun gee whiz think that would be motivating.

Appendix E: Self-Testing of Fertility Tracking Notes

Testing Notes: Mike

BBT Testing

To get a better idea of the challenges women face tracking their ovulation, I recorded my basal body temperature over a period of five days. I used a digital thermometer and recorded my temperature readings in a small spiral notepad with a ball-point pen. I kept both on the table next to my bed. I also kept my mobile phone there, to simulate having a phone-base application with which to record my information.

To use basal body temperature to chart ovulation, women need to take their temperatures the first thing when they wake up and before they get out of bed. I often get up earlier than my wife, who sleeps next to me. So I needed to take my temperature in a dim room without turning on any bright lights so as not to wake her. Then I either needed to jot down the result on paper while still in bed or I needed to get up and go to the bathroom where it's light to jot down my results.

Having a thermometer that lit up would be useful in such a situation. For recording the data electronically, having a thermometer that was integrated with the mobile device (or a thermometer that communicated with the mobile device wirelessly) would be optimal. The phones we're using for prototype testing have a four-way joystick. Using this to select the correct temperature (instead of the numbers on the keypad) might be easier in a dimly lit room. The up and down arrows could increase or decrease temperature values by a tenth. It might also be useful to have large numbers displayed during the input sequence, in case a person wears corrective lenses and doesn't have access to them when they wake up.

If the user expects the temperature to stay relatively constant, with a spike at ovulation, it might be convenient to have the previous day's temperature be the default value when the application starts. This would make it clear that there was a spike at the time the user was recording the information, since the temperature would have changed significantly from the default.

LH Testing

Women can buy ovulation prediction kits over the counter at drug stores for about $20. Testing for ovulation involves urinating on a small white stick, then waiting for a immunological reaction to take place that determines how much luteinizing hormone (LH) is in the user's system. (An LH surge occurs just prior to ovulation.)

We purchased a generic-brand kit at the local Sav-On pharmacy. It included LH tests for seven days. Typically, women will starting testing for an LH surge a few days before it is expected to happen based on the length of their previous menstrual period. Being male, it didn't make any sense for me to wait until a particular day to take the test.

Peeing on the stick requires two hands and can be involve splashing, so the user would not want to have the mobile device in hand when performing the test. As the directions specify, the user also has to wait at least three minutes to read the result, and 10 minutes to verify a negative result. At home, I set my predictor down on the bathroom sink and went and did other things while I waited for the test to complete. I can see wanting to record just the positive results for convenience, since it's just a binary choice. This would mean less work for the user.

Summary

After testing for ovulation using temperature and the LH test, I think using a mobile device instead of, for instance, a PC makes a certain amount of sense since you perform these tests in places where you probably don't have close access to a PC (in your bed or in your bathroom). Quick access to the data entry screen will be key for user satisfaction since you're entering minimal information—a binary result or a decimal number.

Testing Notes: Scott

BBT Testing

When I first wake up in the morning, I usually wake up to my alarm. I tend to get up around 8 am if I've been up late the night before. Because I get up late enough it is somewhat light in the room, but I'm often in a hurry because I have class in less than an hour. I'm also usually very groggy first thing in the morning and have a hard time waking up fully for a while after my alarm goes off. I have my phone and a thermometer next to my bed, so I reach over and stick the thermometer in my mouth and turn it on. I have to lie there for a couple of minutes while the thermometer measures the temperature. It beeps when it is done and I can take it out and check the reading. Even though there is light in my room the reading is a little difficult to read since my shutter is closed. I manage to read the thermometer by squinting through the semi-darkness to see the reading such as 97.9 degrees. I set my thermometer aside again on the table next to my bed.

After getting the reading I fumble groggily with my cell phone to enter the example reading. I have to unlock my cell phone since it automatically locks after 3 minutes. I set the preferences this way since I got tired of things in my pocket automatically dialing people on my cell phone as I walked around. I press 11111 and hit the OK soft button to unlock the phone. I watch for what seems like hours while the phone makes a dippy animation that says "Phone Unlocked" and slowly draws a check box. I'm in a hurry and the extra time for all of these activities is annoying. I navigate through a couple of menus to get a text-message window. It's not too quick to find my text-message window. I use it to enter some text for testing. I enter 97.9 degrees by putting my cell into the numeric mode.

The things I've learned from this exercise are that it would be good to have the menu to enter text available on my cell phone right away instead of having to go through menus. In the morning I'm always in a hurry to get ready or do something since I don't want to wake up earlier than I have to since I'm always tired in the morning. Also making entry as easy as possible would be good since I'm groggy.

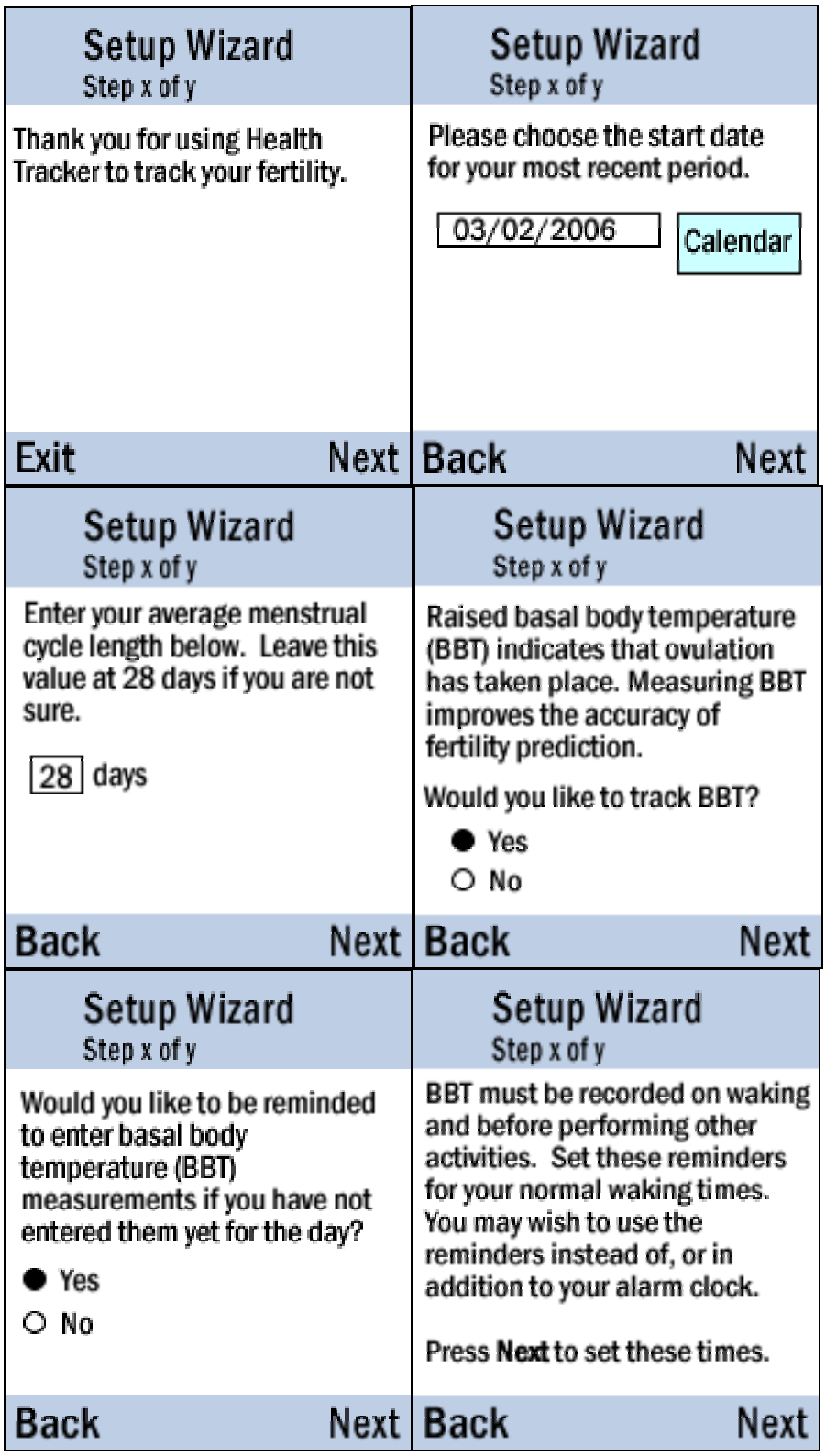
LH Testing

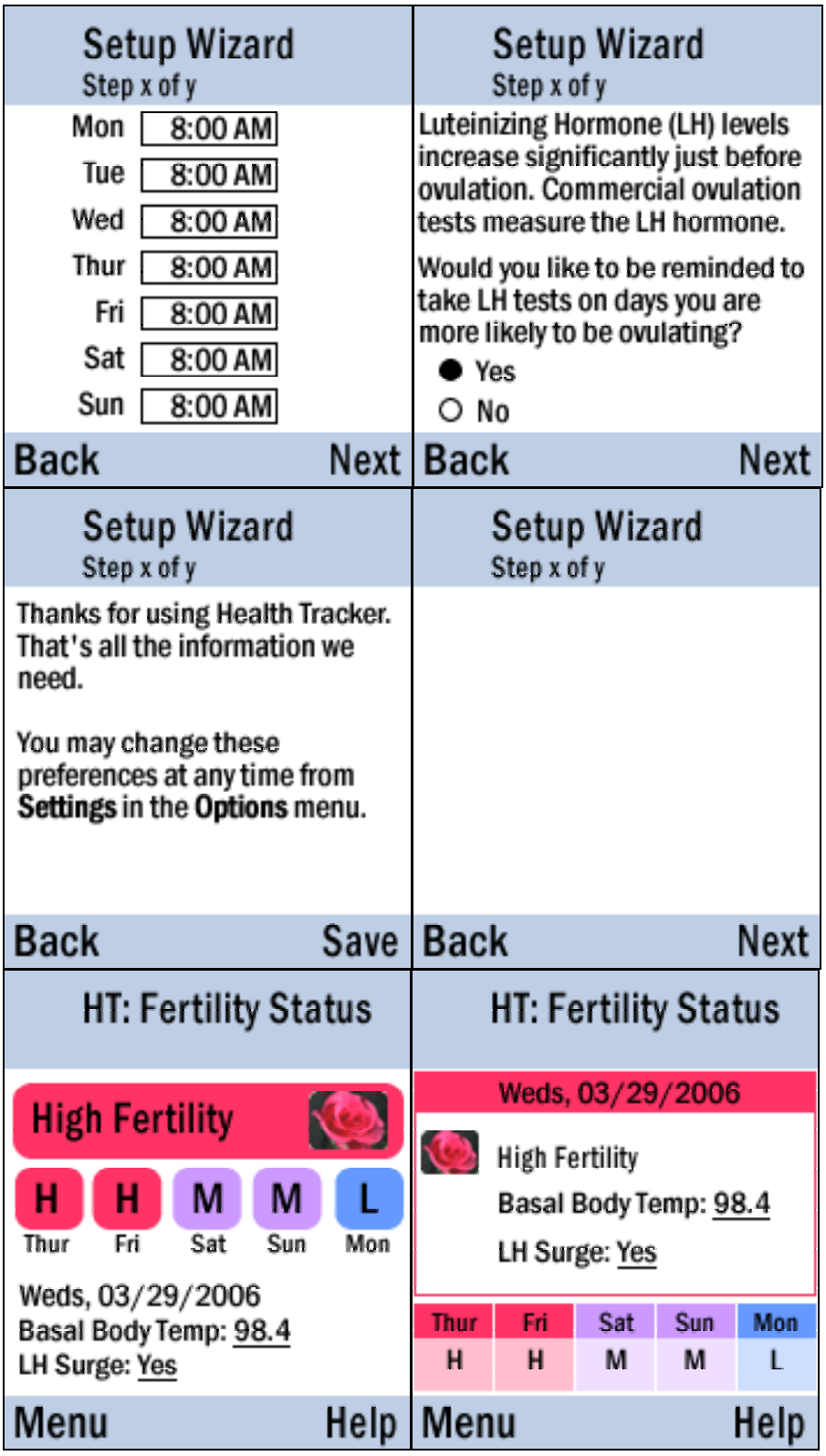
For the luteinizing hormone test I first had to read the instructions carefully. They mention some things that I was not aware of. They say that taking the test between 10 am and 2 pm is recommended, and that I should not urinate for 4 hours before taking the test, if possible. It is hard to remember to do these tasks (take it between 10 am and 2 pm and not to urinate for four hours before taking it). I wait until a day when I'm focused on taking the LH ovulation test, since I've missed my chance today.

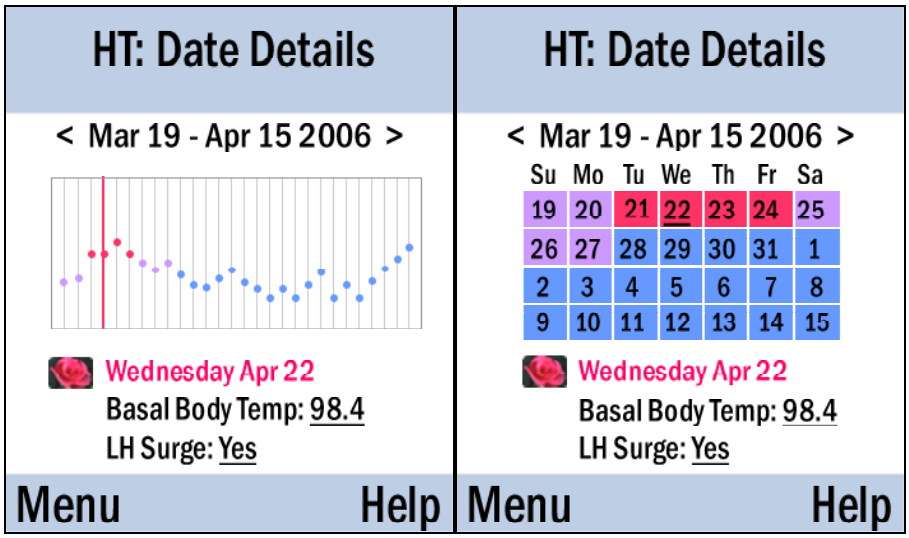
I went into the bathroom and I've looked at the instructions online beforehand. I think I remember how to take the test, but it would be nice to have a brochure explaining it while I'm in the bathroom. I unwrap the test and pull off the cap. I sit down to urinate so that I don't spray urine everywhere by standing up and shooting it at the test. I sit down and urinate towards the end of the stick where it tells me to. It's a bit difficult to position things correctly since we have a tiny toilet seat and it's hard to reach in there and pee on the right part without getting some of the top part of the stick wet. I manage it and put the cap back on the exposed part of the stick. I know I have to wait 5 or 10

minutes to find out if I'm ovulating. I leave the test (with the cap on) on top of the counter, flush the toilet, wash my hands, and go do other things for a while. I come back in 5 or 10 minutes after doing some cleaning in the kitchen for a few minutes. I look at the test and the color where it would change colors is very faint. According to the instructions I am not ovulating since it would be darker if I were. I throw the stick away and pull my phone out of my pocket to record the results. I have to unlock the phone and get to the correct application in order to enter results there. I would want to be able to enter the results in as few steps as possible. I would want to see an option to enter results in the first application screen or very quickly from a menu. I pretend to enter results in a text message.

Appendix F: Paper Prototype #1 Screens


Setup Wizard
Step x of y
Thank you for using Health Tracker to track your fertility.
Exit
Next
Setup Wizard
Step x of y
Please choose the start date for your most recent period.
03/02/2006
Calendar
Back
Next
Setup Wizard
Step x of y
Enter your average menstrual cycle length below. Leave this value at 28 days if you are not sure.
28 days
Back
Next
Setup Wizard
Step x of y
Raised basal body temperature (BBT) indicates that ovulation has taken place. Measuring BBT improves the accuracy of fertility prediction.
Would you like to track BBT?
Yes
No
Back
Next
Setup Wizard
Step x of y
Would you like to be reminded to enter basal body temperature (BBT) measurements if you have not entered them yet for the day?
Yes
No
Back
Next
Setup Wizard
Step x of y
BBT must be recorded on waking and before performing other activities. Set these reminders for your normal waking times. You may wish to use the reminders instead of, or in addition to your alarm clock.
Press Next to set these times.
Back
Next


Setup Wizard
Step x of y
Mon 8:00 AM
Tue 8:00 AM
Wed 8:00 AM
Thur 8:00 AM
Fri 8:00 AM
Sat 8:00 AM
Sun 8:00 AM
Back
Next
Setup Wizard
Step x of y
Luteinizing Hormone (LH) levels increase significantly just before ovulation. Commercial ovulation tests measure the LH hormone.
Would you like to be reminded to take LH tests on days you are more likely to be ovulating?
Yes
No
Back
Next
Setup Wizard
Step x of y
Thanks for using Health Tracker. That's all the information we need.
You may change these preferences at any time from Settings in the Options menu.
Back
Save
Setup Wizard
Step x of y
Back
Next
HT: Fertility Status
High Fertility
H H M M L
Thur Fri Sat Sun Mon
Weds, 03/29/2006
Basal Body Temp: 98.4
LH Surge: Yes
Menu
Help
HT: Fertility Status
Weds, 03/29/2006
High Fertility
Basal Body Temp: 98.4
LH Surge: Yes
Thur Fri Sat Sun Mon
H H M M L
Menu
Help


HT: Date Details
< Mar 19 - Apr 15 2006 >
Wednesday Apr 22
Basal Body Temp: 98.4
LH Surge: Yes
Menu
Help
HT: Date Details
< Mar 19 - Apr 15 2006 >
Su Mo Tu We Th Fr Sa
19 20 21 22 23 24 25
26 27 28 29 30 31 1
2 3 4 5 6 7 8
9 10 11 12 13 14 15
Wednesday Apr 22
Basal Body Temp: 98.4
LH Surge: Yes
Menu
Help

Appendix G: Paper Prototype #2 Screens

Health Tracker Fertility

Welcome to Health Tracker Fertility (HTF). To start predicting your fertility, HTF needs some information about your menstrual cycle.

Press **Next** to enter this information.

Options **Next**

Setup: Length of Cycle

Enter the length of your typical menstrual cycle. If you are not sure of the length, enter 28 days.

28 days

Press **Next** to continue.

Options **Next**

Setup: Period Start Date

Enter the start date of your most recent period.

03/20/2006 calendar

Press **Next** to continue.

Options **Next**

Setup: Fertility Testing

HTF can help keep you keep track of common methods for testing for fertility. (See the HTF documentation for background.)

Press **Next** to continue.

Options **Next**

Setup: BBT Testing

A spike in basal body temperature (BBT) indicates that ovulation has taken place. Will you be tracking BBT?

● Yes
○ No

Press **Next** to continue.

Options **Next**

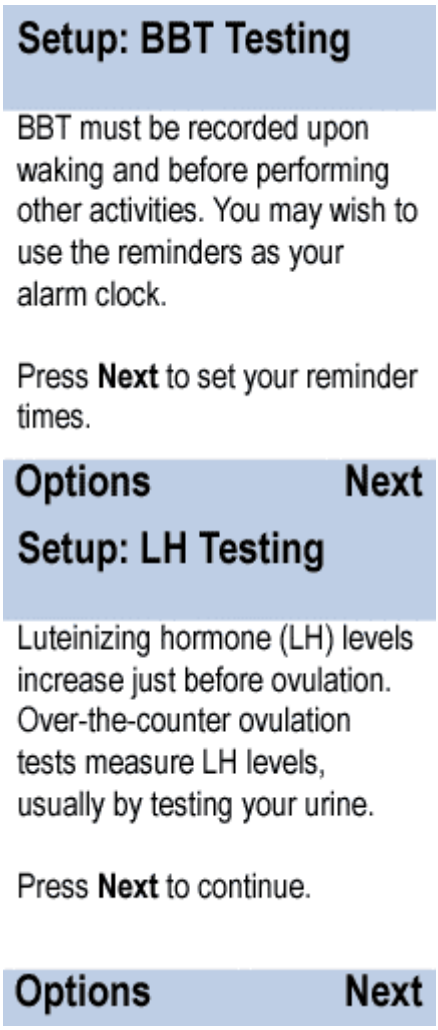
Setup: BBT Testing

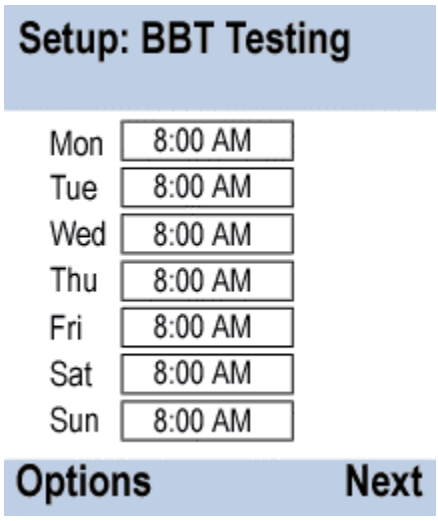
HTF can remind you to enter daily BBT measurements. Would you like to set up BBT reminders?

● Yes
○ No

Press **Next** to continue.

Options **Next**


Setup: BBT Testing
BBT must be recorded upon waking and before performing other activities. You may wish to use the reminders as your alarm clock.
Press Next to set your reminder times.
Options
Next
Setup: LH Testing
Luteinizing hormone (LH) levels increase just before ovulation. Over-the-counter ovulation tests measure LH levels, usually by testing your urine.
Press Next to continue.
Options
Next


Setup: BBT Testing
Mon 8:00 AM
Tue 8:00 AM
Wed 8:00 AM
Thu 8:00 AM
Fri 8:00 AM
Sat 8:00 AM
Sun 8:00 AM
Options
Next

Setup: LH Testing

Will you be tracking LH levels using ovulation tests?

● Yes
○ No

Press **Next** to continue.

Options Next

Setup: LH Testing

Would you like LH testing reminders on the days when you are more likely to be ovulating?

● Yes
○ No

Press **Next** to continue.

Options Next

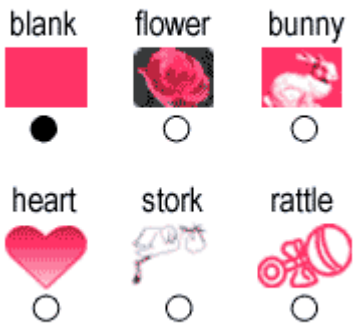
Setup: Select Icon

You can select an icon to be displayed on HTF's ferrtility alerts. The icon will change from blue to lavender to pink as fertility increases.

Press **Next** to select an icon.

Options Next

Setup: Select Icon



Options Next

Setup Complete

That's all the information HTF needs to starting tracking your fertility. You can update this information by selecting **Settings** under the **Options** menu.

Press **Next** to go to the main screen.

Options Next

Health Tracker Fertility

Today: Wed, 03/29/2006

High Fertility

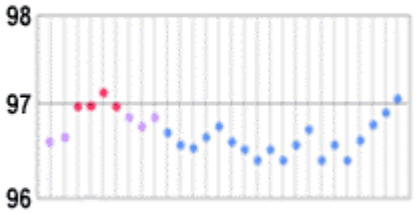
Basal Body Temp: 97.9
LH Test: Positive
Period: No Data

Thur	Fri	Sat	Sun	Mon
High	High	Med	Med	Low

Options

BBT Graph View

< Mar 19 - Apr 15 2006 >



BBT predicts next high fertility:
Fri, Apr 28 - Mon, May1

Options Next

Calendar View

< April 2006 >

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Period Low Medium High

Options Back

Enter BBT Data

Please record your basal body temperature for 3/29/2006.

Temperature: [ ]

Options Save

Enter LH Data

Please record the result of your LH test for 3/29/2006.

- ● negative
- ○ positive

Options Save

Send Data

You are sending the following:

Status: High Fertility
Basal Body Temp: 97.9
LH Test: Positive
Period: No Data

Press **Next** to select a recipient.

Options **Next**

Send Data

You may include a personal message (50 characters max):

Press **Send** to send your data.

Options **Send**

Send Data

Data sent!

Options **Next**

Send Data

Options **Select**

[List of selectable contacts]

Appendix H: Reminder Testing Pre-Test Survey

Thanks for helping us improve Health Tracker!

The goal of the Health Tracker project is to help people easily monitor important health-related lifestyle information using mobile devices. For our semester-long project, we've decided to focus on fertility. We are designing a mobile-phone application that helps women record the results of common fertility tests and then predicts when they are most likely to conceive based on the results of the tests.

This week-long user test will focus on the aspect of the application that reminds women to complete their daily fertility tests.

The Test Simulates Tracking Your Basal Body Temperature (BBT)

When a woman ovulates, her basal body temperature (BBT) rises slightly. This rise helps prepare the body to receive a fertilized egg. (See our brochure for more background information about BBT and fertility.) Tracking BBT over time can help a woman predict her days of highest fertility. Health Tracker can remind women to take their BBT each day and enter that information in the application.

You Will Receive Daily Text-Message Reminders

During the user test, which will last for seven days, we will be sending you daily text messages that remind you to take your BBT and record the information in Health Tracker. As part of the test, you can either take your real temperature or you can make up the temperature readings. Since BBT needs to be measured just after waking and before performing other activities, we will send you reminders around the time when you get up in the morning. If you want, you can use the text message alerts as an alarm clock.

You Will Record Your BBT Information on a Paper Prototype Notepad

You won't be entering your BBT data on a mobile phone. Instead, you will have a "paper prototype" notepad with printouts of the screens that you would see on a phone. Each day that you get a text message reminder, you will need to fill in a few pieces of information on the notepad. You can either enter the data immediately after you get your text message, or you can use the "snooze" feature and enter the data later in the day. We will only send you one text message each day.

If for any reason you are unable to enter data for a day, please indicate that on the notepad. It is fine if you have difficulties making entries—we want to understand the process and factors that can make entering data difficult and address such factors in our design. While you may make up temperature data, please do not make up information about when you entered data since having accurate information about data entry is critical to helping us understand the how people use the system.

Thanks for your help!

Background Questions

Participant # ____ (filled in by Health Tracker group)

Please select your age range:

__ 21-30 __ 31-40 __ 41-50 __ 51-60 __ 60 or older

Please check the features you commonly or occasionally use on your mobile phone or PDA?

__ Contact List __ Calendar __ To-do list __ Note pad __ Text Messaging (SMS)

__ Camera __ Alarms __ Internet __ Other Applications, specify: _____

Have you used a paper diary system before? __ Yes__ No

Have you used an electronic diary system before? __ Yes __ No

If you feel comfortable, please describe the purpose of any diary system you've used before (such as diet, exercise, disease management).

When would you like to be reminded to "take" basal body temperature each of these days? Ideally these times should be near your normal waking time. If you do not have a set waking time on a day you may wish to enter a later time that you know you will already be awake.

In a final system you would not receive a reminder if you had already entered data for the day before the reminder was set to go off.

Monday_____
Tuesday _____
Wednesday _____
Thursday _____
Friday _____
Saturday _____
Sunday _____

Appendix I: Reminder Testing User Journal Forms

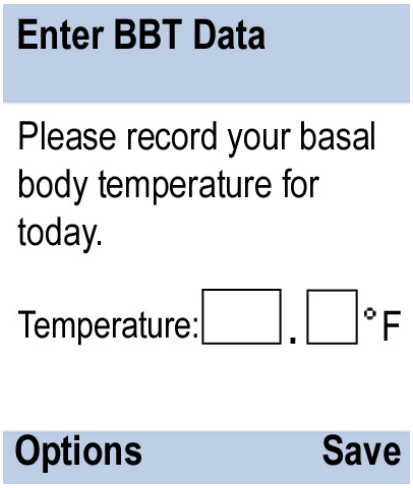
User Testing of Daily Reminders

Health Tracker Team:

Carrie Burgener (carrie@sims.berkeley.edu)
Scott Fisher (sbfisher@sims.berkeley.edu)
Mike Wooldridge (mikew@sims.berkeley.edu)

Day 1

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

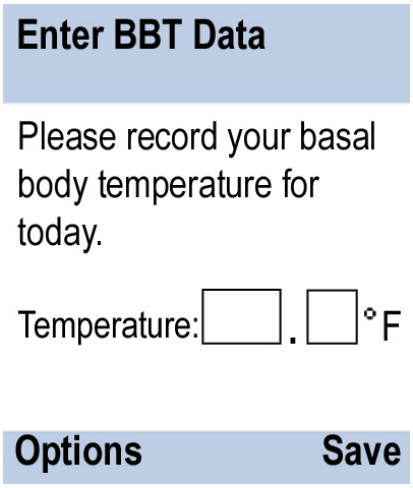
Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Day 2

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

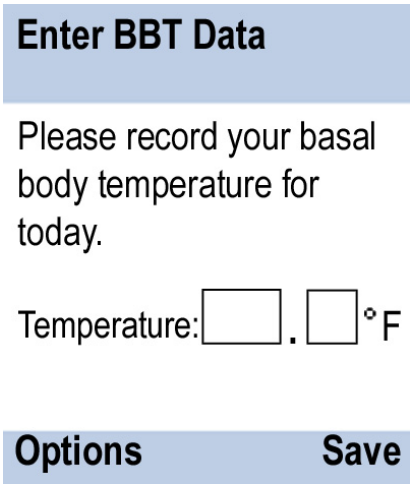
Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Day 3

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

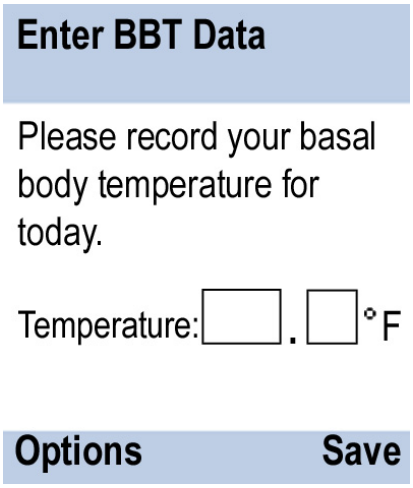
Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Day 4

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

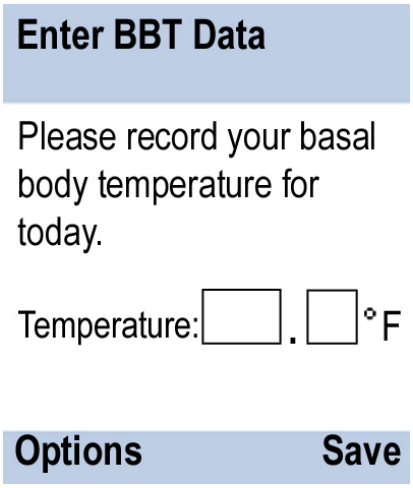
Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Day 5

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

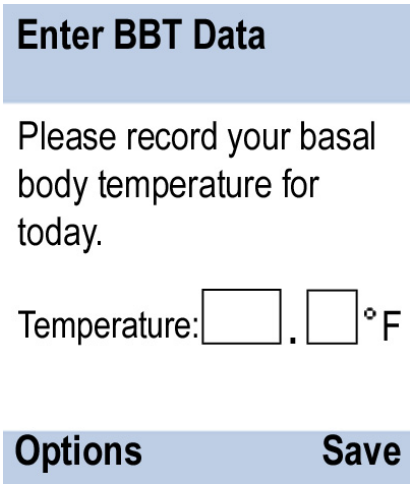
Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Day 6

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

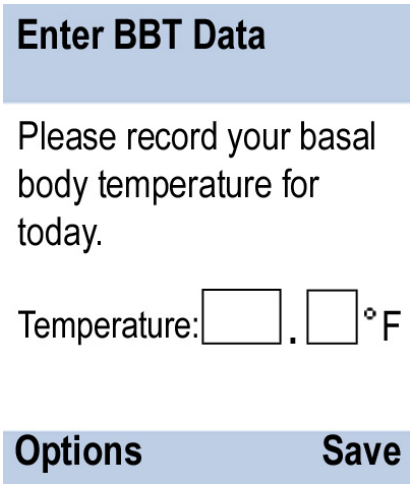
Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Day 7

STEP 1: The screen on the right appears in Health Tracker. Enter your basal body temperature in the text boxes. (You can record pretend temperature data if you prefer.)



STEP 2: Enter the date and time you are recording your basal body temperature (i.e., the current date and time).

Date: _____ Time: _____

STEP 3: Enter some additional feedback about this entry.

Did you receive a text message OK?

Was the text message helpful in reminding you to enter your data?

Did you record your information immediately after receiving the text message, or did you opt to use the "snooze" feature?

If you did not record your basal body temperature today, why not?

Any other thoughts?

Appendix J: Reminder Testing Post-Test Survey

Participant # ____

What did you like and dislike about the reminders you received?

What did you like and dislike about the paper prototype screens and information you filled in?

Did you find it difficult to complete the reminder tasks? Why?

If you were using this application, would you want to get reminders? Why or why not?

How long would you like the snooze feature to wait before reminding you again?

Would you want to track health information using a mobile device in the future?

Appendix K: Fertility Brochure

(see on following pages)

Welcome to Health Tracker

Health Tracker Fertility

ALWAYS EASY, ACCURATE AND CONVENIENT

Table of Contents

Welcome to Health Tracker Fertility 1
Some Fertility Basics 1
Fertility Signs to Monitor 1
Recording Information on Your Mobile Phone 2
When You Begin Using Health Tracker Fertility 4

Welcome to Health Tracker Fertility

Health Tracker Fertility (HTF) is software that enables a woman to keep track of certain physical signs in order to predict when she is most and least fertile. This can be valuable for

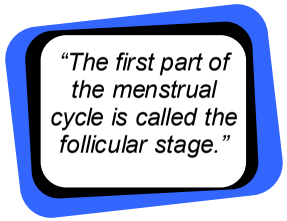
- Couples or women trying to conceive
- Women who are undergoing fertility therapies
- Those who wish to reduce the chances of conception
- Those who just want to be more aware of their bodies

Some Fertility Basics

Although most women are knowledgeable about their menstrual cycle, they may not be as aware of their fertility cycle, which is related to the menstrual cycle.

Day one of the menstrual cycle is when menstruation begins. During this phase, a woman's body sloughs off extra blood and tissue from the uterus. The shedding process lasts from 3 to 5 days in most women. The uterus is not a friendly environment for fertilization during menstruation.

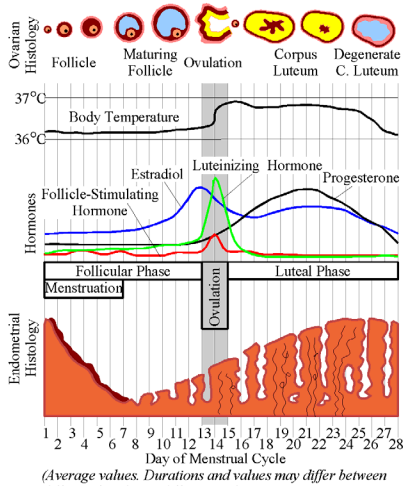
The first part of the menstrual cycle, from first menstruation until egg release, is called the *follicular stage*. During this time, the egg-bearing follicles in the ovaries prepare themselves to release an egg. This period generally lasts between 12 and 14 days.



When the follicle finally matures, it releases the egg or *ovum* into the fallopian tube. The release of the egg is called *ovulation*. Ovulation is encouraged in the body by a sharp increase in a hormone called *luteinizing hormone* or *LH*. The LH spike helps weaken the follicle wall, which causes the release of the egg. A woman is most fertile near the time of ovulation in her cycle.

Ovulation generally takes place about 14 days before the end of the menstrual cycle and is accompanied by changes in the body.

Some of the changes indicating fertility include the spike in LH levels, increased body temperature, and changes in cervical mucus consistency and cervical position. By observing and tracking changes in their bodies, women can get a good idea when ovulation is taking place and can increase or decrease their chances of conception.



(Average values. Durations and values may differ between different females or different cycles.)

The period following ovulation until the beginning of the next menstrual cycle is called the *luteal phase* and is marked by a gradual decrease in fertility. The luteal phase lasts until the beginning of the next menstrual cycle.

Fertility Signs to Monitor

Women who want to predict their fertility need to systematically monitor signs in their bodies and record information about those signs. Having accurate data increases the accuracy of fertility predictions. Many signs can be tracked, but the ones most frequently tracked are

- The beginning of each menstrual cycle
- The length of the menstrual cycles
- The “base” temperature of the body when first waking
- Changes in LH that indicate ovulation

Recording the beginning of the menstrual cycle when menstrual bleeding first occurs gives women an idea of how far along they

are in their cycle and how likely it is that they might be fertile on a given day.

The length of the menstrual cycle is the number of days from first menstruation in one cycle to the day before menstruation occurs in the next cycle. Knowing the length of the menstrual cycle can be important since the fertile time in a cycle may change depending on the cycle length. For most women, a menstrual cycle lasts about 28 days.

The "base" temperature of the body is known as the *basal body temperature* or *BBT*. The basal temperature is measured in the morning just after waking up and before getting up, walking around, or performing other activities. Measuring temperature after performing other activities will result in a higher temperature reading since it will make the body "warm up." A woman who is ovulating (or has ovulated already) will have a slightly higher BBT than she had during the first part of her cycle.

Even a very small rise in temperature may indicate that ovulation has occurred. A special thermometer with accuracy of at least 0.1 degree is needed. An accurate thermometer such as this is called a *basal thermometer*. Such thermometers are widely available at drug stores and pharmacies.

As mentioned earlier, luteinizing hormone increases or *spikes* just before ovulation occurs. A high level of LH is a good indicator of high fertility. Women can measure their LH levels with ovulation tests from drug stores or pharmacies. These ovulation tests (also known as LH tests) are similar to home pregnancy tests.

A typical test instructs a woman to urinate on part of a test stick, wait for 5 to 10 minutes, and then check an indicator on the stick to see if the LH level is high or low. The tests often have specific requirements such as not urinating for a few hours before taking the test. The tests generally must also be taken between mid-morning and late afternoon.

Recording Information on Your Mobile Phone

Fertility can be tracked manually with paper and pencil or with traditional computer software. There are a number of advantages to recording data with a mobile phone, however.

- People tend carry their mobile phones with them or have them nearby most of the time. This can be convenient for recording fertility information.
- Mobile phones can alert users to perform tests or record data.
- Fertility predictions and calculations can be made by the phone. The user does not have to count days on a calendar or scan previous fertility diary entries.
- Since cell phones have small screens, the information is less likely to be seen by others.
- People generally don't share their mobile phones, which enhances privacy.
- A phone can transfer fertility informatioin to others—for example, to a partner or doctor—if sharing is desired.

When You Begin Using Health Tracker Fertility

When you set up HTF for the first time you will be asked to enter some basic information about yourself and your menstrual cycle so that Health Tracker can begin making accurate fertility predictions.

You will also be asked to set up preferences for the tests you would like to track. You can track basal body temperature readings, LH test results, or both.

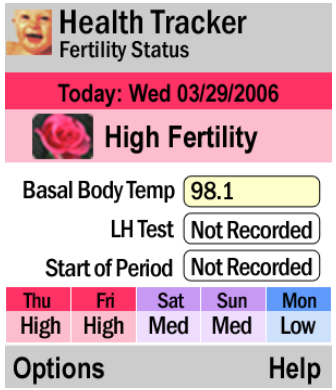
It's a good idea to track both types of measurements to get the most accurate results.

You will have the opportunity to set up alarm and reminder settings that are convenient for you.

You may change any of the basic information and preferences at any time by accessing the **Options** menu in the application.

After basic setup is complete, you will be able to record, view or edit information from the main screen of the Health Tracker application. The main screen shows predictions of your fertility for the current day and the next five days. It also allows quick access for entering test results.

Additional help information is available in the application if you have questions.



We hope the application helps you with your fertility-related goals. Thank you for using Health Tracker Fertility!

Health Tracker

School of Information
University of California

http://www.health-tracker.info

carrie@sims.berkeley.edu
mikew@sims.berkeley.edu
sbfisher@sims.berkeley.edu